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NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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RECONSTRUCTION IN EUROPE

EVEN in the stress and strain of the war itself, the widespread concern as to the steps to be taken to ensure that our efforts are not once again in vain is unmistakable. Only the creation of a new order founded on truth and justice can compensate for the sacrifices that have to be made, and the creation of such an order involves the co-operation both of belligerents and of neutrals. The extent to which this is evident is one of the most significant differences in the present temper of the nation in contrast with its entry into war in 1914.

While, however, it is well to bear in mind our failure to give effect to our purpose twenty years ago, there are to-day advantages which we did not then possess. The economic distress and confusion into which the life of Europe had been thrown would have endangered any political system. The design of the League of Nations demanded much larger ideas and sympathies than those which guided the treaty makers at Versailles, and surrender to the passions of the hour placed fatal obstacles in the way of the success of the new system. The mistakes and failures of the past are ours to profit by in the attempt to build again on ampler lines.

Nor should we write off the League of Nations as a complete failure. One of the most encouraging features of the last two decades has indeed been the success of its work in certain technical fields such as health, communications and transport, the welfare of women and children. That work remains and continues, as does the work of its sister body, the International Labour Organisation, and their significance will increase.

Many believe that the real weakness of the present League of Nations lies in the retention of national sovereignty. They take the view that no system of collective security can be effective unless it is part of a plan for federal government. Essentially this point of view was foreshadowed by de Madariaga in 1937 in "Theory and Practice in International Relations", and more fully in his later "The World's Design". De Madariaga insists that the nations must discard the habit of thinking of foreign affairs because there are only world affairs, and that behind any machinery, such as the League or a reformed league, for world government, there must be a sufficient body of world citizens endowed with the necessary world patriotism to give world statesmen their inspiration and guidance.

It is on the foundation of a world community that de Madariaga bases his design, the building of world institutions such as a world administration to govern mandated territories, a world bank, a world trade commission and the utilization of existing international institutions, proceeding *pari* *passu* with the promotion of a sense of world citizenship. In the moral basis which he advocates, de Madariaga is arguing on similar lines to Curtius in his brilliant "Civitas Dei", and his contention that, by starting with certain practical problems, the professional interest in getting a problem properly solved may gradually come to eliminate others and substitute the disinterested, rational, exploratory type of mind for the acquisitive, the dogmatic or authoritative, will commend his approach to scientific workers.

Proposals of this type would conserve what is most worth while and possibly gain time for the development of a sufficiently advanced world opinion for acceptance of the idea of some form of federal government or union. This latter idea is outlined in detail in C. V. Streit's "Union Now". The general principle of a federal solution is reasonable in its fundamental premises, and many would be disposed to agree, at least in theory, with proposals to establish a federal government with supreme and single authority to use armed force against aggression by any nation or group outside the Federal Union, to control the use of raw materials in undeveloped territories now subordinate to its members, and to undertake the education of backward communities without racial discrimination.

For some such objectives as these much support could be found. The New Commonwealth, a body which has advocated the creation of an international police force, has been one among numerous factors disposing many to accept the limitations on national sovereignty involved in a federal or commonwealth solution. It is in the means to be taken to achieve a federal union, and the exact extent and nature of such a union that differences of opinion arise, and the practical difficulties are much greater than Mr. Streit is disposed to admit in his facile argument for union now.

Mr. Streit advocates a union of fifteen democracies of the North Atlantic, including a common citizenship, defence force, customs system, currency and postal and communication system. He urges that such a union would be so powerful in its combined resources as to assure peace to its members from the start through overwhelming preponderance and invulnerability. This number is chosen as the most practical nucleus for the organization of world government, and providing geographically, culturally, commercially, financially, politically, and historically, a cohesive nucleus. A start with the democracies is essential, because Mr. Streit proposes to base it on individual citizenship and not on the State itself as unit.

From this start Mr. Streit contemplates the growth of the Union into universal government by peaceful accession to its membership and by co-operation from the start with non-members. Despite, however, the force of Mr. Streit's contention regarding the rich heritage of the democracies in freedom and justice, we may well feel that he is unduly optimistic in arguing from American or Swiss experience as to the rate of progress in achieving such a federal union, and this view is not dispelled by his brusque treatment of the way in which the problems of a common defence force, currency, customs and postal systems are to be solved. Apart altogether from such details, there are other opinions as to the extent of federalism which should be our immediate objective, and the wisdom of scrapping entirely the experience and organization already obtained in international co-operation.

Mr. Streit's plan for union is based essentially on community of ideas and interests. An alternative to this is the Continental basis, essentially as advocated by Briand in his proposal for a European Union, though here also there is some community of ideas. Briand's plan, which lapsed largely through the refusal of Great Britain to link her fate with that of the Continent, has been revived in essence in the European Federation recommended by Count Coudenhove-Kalergi, who visualizes the world as moving towards a large group system. The Pan-American Union being organized by the United States and the Soviet Union are already examples, and a great Mongol block in the Far East is possible in the future. The peoples who care for justice, international law and the rights of men must work for the organization of Europe on good principles and under democratic influences, or that organization will be done by other hands.

A European federation might be easier to secure than the union advocated by Mr. Streit, and involve less risk in attaining it. The attitude of Great Britain will be as decisive a factor in achieving the United States of Europe as the attitude of the United States of America would be in the establishment of the Union of Mr. Streit's plan. What is most important, however, at the moment is not the choice between one plan and another, but the careful and impartial examination of the problems which have to be faced by any system of union, whatever the powers it bestows on the Federal Government.

A main argument for Mr. Streit's plan is that the peoples embraced in his Union are all with long experience of Parliamentary government, and that their economic strength and command of essential materials would be able to assure peace. Count Coudenhove-Kalergi contends that this in itself would be a provocation to the non-democratic powers and would facilitate Germany's dream of creating a federation in Central and Eastern Europe in which she would play the part Prussia played in Bismarck's German federation. His plan would offer Germany and Italy a place in the federated Europe, and while their claims to domination would be resisted, the whole of Europe and a great part of Africa would be their living space.

Unquestionably a Europe organized on a basis of close co-operation between the several States would provide peaceful and constructive opportunities for the varied elements in Germany. Co-operation between such a federation and the Pan-American Union could scarcely fail to secure the peace of the world.

A major difficulty will, of course, be the safeguards to be provided against a repetition of aggression. It is for this reason that we must think of the settlement after the present war not simply in terms of ideals or of military or political force, but as an essentially practical problem—that of utilizing to the maximum the enduring moral and constructive forces which already exist and applying them to the changing conditions as well as supporting them with adequate combinations of force. This factor alone should render us chary of discarding too readily the League of Nations, and should induce us to examine rather more carefully than Mr. Streit has done the causes of its failure or impotency.

Mr. Streit's examination of the League is somewhat warped by preconceived ideas. The League and a federal system are not, as he assumes, necessarily opposed ideas. The League Covenant, for example, lays heavy limitations on national sovereignty, and under it the way is open for gradual and successive further surrenders of national sovereignty until an effective federal scheme is built up. There is at least reason for legitimate doubt whether, if the League has failed because its member States were unwilling to observe its more moderate limitations in their national sovereignty, there is any real prospect at the present time of their entering a federal system which involves an immediate and much more drastic surrender of the essentials of national sovereignty.

Granted that the federal idea probably offers the best ultimate prospect of achieving a lasting peace, the practical question is rather the steps by which we are to advance to that position, more especially when we take into account that the evolution of the British Commonwealth, for example, so far as the Dominions are concerned, is away from any kind of union. In such circumstances, it is imperative to build on any solid foundation that lies to hand.

Reference has already been made to experience and directions in which the work of the League of Nations and of the International Labour Organisation offers hope of further advance or success, and the studies or work on population questions, including migration, and on nutrition are of special promise in this respect. Beyond this we have in being to-day, in the Supreme Council and the Allied High Command, a standing organ of government with a powerful influence over two distinct Sovereign States, and a combination of armed forces under unified control. If these arrangements were kept functioning after the war, a nucleus would be provided on which an international body could be built.

If a way forward to increasingly close combination of European nations is at least possible, the forms of organization which the war is compelling us to adopt for negative purposes could equally be turned to the positive purpose of developing world resources by finding a beneficent outlet for the constructive energies of all peoples. Much progress has been made in establishing successful international commodity schemes, which form instruments of orderly development and are also powerful economic weapons. Steel, tin, zinc, aluminium, rubber, sugar, meat and other vital products are already under some form of international control. The technique of operating such controls is rapidly improving, and consumer interests are being increasingly brought to bear on their operation. This process would be assisted by the creation of an international supervisory body such as a Cartel Commission of the League of Nations, with strong personnel and powers to ensure publicity.

It is difficult to over-estimate the possibilities of such schemes. They have given the world an instrument for the scientific adjustment of expanding production to expanding consumption, thus reducing the chances of further acute world depressions, with their shocks to the stabilizing factors in international relations. The establishment of wind-breaks against economic blizzards of the severity of those of the period of 1929–32 is essential for peaceful and orderly political development.

Moreover, world economic organization appears to be approaching the point when international finance and trade can be greatly assisted by the concerted use of new methods. Internationally organized marketing, supported by international public works, might now be able to give for the first time a peaceful and lasting outlet for the world's energy comparable in scale with that which war supplied in the past. Already, impartial and scientific studies of such problems, often under the ægis of the League of Nations, have provided a basis for cash and price insurance schemes for the world's farmers, measures of conservation for soil, water, fauna and flora, education and health services and modern systems of taxation in backward countries, on a scale impossible even a few years ago. Here may lie a channel the further scientific exploration of which might provide a solution of the problems of colonies and raw materials.

The fact that in many fields the basis for a scientific attack on outstanding problems has already been provided is at least encouraging, and the possibilities of advance are greater than a quarter of a century ago, even if many difficulties remain. That the problems of reconstruction are already being discussed is a further hopeful sign, and evidence that the mistake of postponing until after victory in war the thought and study concerning the needs and structure of a new Europe will not be repeated. Preparation for the tasks of peace cannot be left until they suddenly and urgently arise, to be dealt with in an atmosphere of bitterness, weariness and economic chaos.

There is much to be said for the immediate appointment of a body of able and far-sighted men, chosen irrespective of party attachment, to begin at once the study of this most vital problem. In that study the co-operation of neutral countries should already be possible, and the way should be open for German co-operation immediately the present tyrannical leadership of that country has been replaced.

The contribution of scientific workers will be essential in the investigation of many of the problems of reconstruction which must be solved if we are to build a new Europe. The scientific spirit must be an effective influence if an impartial solution is to be obtained undisturbed by prejudice or vested interests; and scientific workers no less than other members of the community have their part to play in seeing that the problems of peace are approached now in a magnanimous and serious spirit, with the courage, vision and resolution which are essential if a new order in Europe is to pass from a dream into reality.

ISLAM'S CONTRIBUTIONS TO SCIENCE

La science arabe et son rôle dans l'évolution scientifique mondiale
Par Aldo Mieli. Avec quelques additions de Henri-Paul-Joseph Renaud, Max Meyerhof, Julius Ruska. Pp. xix+388. (Leiden: E. J. Brill, Ltd., 1939.) 12.50 guilders.

IT is only within the last half-century that systematic investigations have been made into the part played by Islam in the development of science. Earlier estimates of its importance were mainly conjectural and thus variable, religious prejudice tending to depreciation and the principle *omne ignotum pro magnifico* to exaggeration. One of the first serious attempts to set the inquiry upon a proper basis, by direct reference to original sources, was made by M. P. E. Berthelot, who in 1893 published the Arabic text of certain Muslim alchemical treatises in his "Chimie au Moyen Âge". Other very valuable pioneer work was carried out by E. Wiedemann (on Arabic chemistry and physics), M. Steinschneider (mainly bibliographical), H. Suter (on Muslim mathematicians), E. G. Browne, L. Leclerc and L. Choulant (medicine), and M. J. de Goeje (geography). More recently, Muslim chemistry and mineralogy have been closely studied by J. Ruska, H. E. Stapleton and P. Kraus; medicine (particularly ophthalmology) by M. Meyerhof; mathematics by Salih Zaki of Istanbul; and Muslim philosophic thought in general by Baron Carra de Vaux and De Lacy O'Leary. This list, though representative, includes only a small fraction of the large band of scholars to whom the publication of very numerous Arabic texts—with translations, commentaries, glossaries, notes, and all the other impedimenta of learning—is due. Complementing these labours, and indeed often their condition precedent, are such monumental works of reference as the "Encyclopædia of Islam" (now successfully completed), C. Brockelmann's "Geschichte der arabischen Litteratur", and G. Sarton's "Introduction to the History of Science".

Sufficient data have therefore been amassed to make a general estimate of Muslim science both possible and desirable ; and M. Aldo Mieli has now provided us with it in the work under notice. M. Mieli, as permanent secretary of the International Academy of the History of Sciences, and himself an erudite historian of science, was in a situation peculiarly favourable to the composition of such a work of synthesis. Enjoying the personal friendship of the leading investigators (some of whom, namely Adnan, Brunet, Meyerhof, Renaud and Ruska, read the proofs), and editing *Archeion*—one of the principal journals devoted to the history of science—he could be sure that nothing of first importance escaped him, while errors would almost certainly be detected. But though M. Mieli was thus fortunately placed for his venture, and though he makes generous acknowledgments to his helpers, it is clear that the main credit for an excellent book is his alone. His material is admirably arranged, his style is clear and pleasant, and the book is well annotated, documented and indexed. It may be read without difficulty by those with a merely general interest in the development of science during an obscure period, but provides also a remarkably useful résumé for the specialist. The bibliographies, though not claiming to be exhaustive, include references to the chief authorities, and are supplemented by lists of various important texts still unpublished : an invitation to scholars which will attract new recruits while spurring on the veterans to further efforts.

In the introduction to his book, M. Mieli points out that Arabic science forms the connecting link between the natural philosophy and technology of antiquity and the scientific knowledge of modern times. To exhibit his subject in the proper setting, therefore, he begins with a short but skilful survey of Indian, Egyptian and Greek science. Even in his self-imposed brevity, he finds space for a dig at the philologists who attempt to interpret classical scientific or technical terms without a knowledge of the science or art concerned. He reminds us of the familiar conception of triremes as ships propelled by three *superimposed* banks of rowers, and says that while this conception is impeccable from the philologic point of view, "un pêcheur quelconque de vos côtes aurait pourtant pu rire au nez de monsieur le philologue qui aurait voulu lui affirmer que de tels navires, si même ils avaient été construits, auraient pu naviguer". In point of fact, as was shown by Lefebvre de Noëttes in 1935, the three sets of rowers in a trireme were disposed horizontally, not vertically.

M. Mieli then proceeds to describe the rise and development of Islam, devoting special attention to the tenets of the Ismā'ilite sect, which had so great an influence upon the later character of Muslim scientific philosophy. The celebrated encyclopædia of the Ikhwān al-Safā (Brethren of Purity), for example, is permeated by Ismā'ilite doctrine, while according to Kraus the works ascribed to Jābir ibn Ḥayyān were also products of the same sect. In the body of the book, the author treats his subject partly by period, partly by the particular branches of science, and partly under the names of distinguished individual savants such as Al-Bīrūnī, Al-Rāzī and Maimonides. This method allows considerable flexibility and increases the ease with which the book may be read. In less adept hands, it might have led to a staccato scrappiness, but in fact its results here have been very satisfactory

After dealing with Muslim science at its zenith, M. Mieli describes the process, or rather processes, by which it was transmitted to the West. There were at first sporadic and often somewhat curious infiltrations, as for example when the merchant-turned-doctor Constantine the African emigrated from Carthage to Salerno, became a Christian, and inoculated the Salernitan School with a passion for Muslim medicine (eleventh century). More ample contacts between Islam and Latin Christianity were made in Sicily, in Moorish Spain, and through the medium of the Crusades. Countless translations were made, and countless European students sat at the feet of Muslim teachers, so that in a surprisingly short space of time the Arabic version of Greek science, together with the large contributions to knowledge made by the Muslims themselves, became immediately and universally available. By a strange coincidence, the transmission once made, Muslim civilization and science alike evolved rapidly to an irremediable decadence.

The remaining portions of the book deal with bibliographies, with certain Arabic scientists and writers posterior to the thirteenth century, and with the constitution and aims of the International Academy of the History of Sciences. The index of names is divided into three parts : (1) persons who lived before the Hegira, (2) persons living between the Hegira and the end of the twelfth century, and (3) persons living in the Christian West, since the fourteenth century. The last part includes the names of modern authorities.

E. J. HOLMYARD.

A DEFENCE OF VITALISM

Vitalism: Its History and Validity
By Dr. L. Richmond Wheeler. Pp. xii + 276. (London: H. F. and G. Witherby, Ltd., 1939.) 15*s.* net.

MANY readers of Radl's "History of Biological Theories" and Woodger's "Biological Principles" must have been left with the feeling that biological theories are quite incoherent and biological principles non-existent. Dr. Wheeler has set himself to correct the impression left by such excessively impartial discussions. His book is a history of vitalistic theories and a defence of this point of view. It is a praiseworthy but incomplete attempt to do something extremely difficult. To complete the task satisfactorily would mean a complete history and criticism of the development of scientific thought and its varying background. As vitalism has been an attempt to supplement or set aside the traditional categories of physical science, these have to be examined first. The task is not made easier by the way that vitalists and mechanists in their age-long contest have repeatedly shifted their ground and changed their weapons. If there is a clear and permanent difference between the antagonists, it may be one of temperament as much as anything else. The mechanist is the kind of person who feels that everything important is known already, in principle at least, and that only minor details remain to be discovered. The vitalist feels that existing knowledge is only of minor details, and everything of importance is undiscovered.

The author's brief treatment of the seventeenth and eighteenth centuries is scarcely adequate for the period when the foundations of modern scientific and philosophical thought were being laid. In those days, too, the division of opinion was better defined. The vitalists really believed in 'vital forces'. The mechanists really believed in the all-sufficiency of Newtonian mechanics. In fact, Hobbes believed it when the science of mechanics was scarcely more than a hope and an aspiration. In the nineteenth century the controversy became more confused. The mechanists could not rely on mechanics only but had to add chemistry to their list, regardless of the fact that chemistry was an autonomous science owing very little to physical theory and called mechanical only by courtesy. The vitalists on the other side began to fight shy of vital forces and call them by other names.

In the present century the wholesale reconstruction of physical theory has made further complications. Dr. Wheeler says (p. 172): "Vitalism and mechanism are the only two types of theoretical biology yet devised and both involve the analogy of a humanly constructed machine. Vitalism allows for a mechanic. Mechanism forgets that a mechanic is essential . . ." This is true enough of the traditional controversy and is still true of some of the controversialists, but not of all. If it is true, does it not condemn both sides? The analogy of a humanly constructed machine is, to put it mildly, a dangerous one and may be entirely wrong. There have not been lacking thinkers who pointed this out and for various reasons refused to take either side. Dr. Wheeler is scarcely fair to these 'cross-benchers', and tries to count them in on his side. For example, he scarcely considers the positivists at all. Mach is just mentioned in passing as an anti-mechanist. It is true that positivists deny any absolute truth to mechanical theories, but they are admitted to a secondary sort of truth as "conceptual shorthand" or "convenient fictions" if they help to predict observable facts. But vitalist theories would be utterly condemned as metaphysical and of no heuristic value. Positivism, however seriously mistaken, is an interesting and influential type of theory that should not be ignored. J. S. Haldane, too, is treated as a vitalist, though he always said he was not. His contention was not quite the usual one, that biology is an autonomous science with its own concepts and methods distinct from those of physics, but that the special concepts of biology are really prior to those traditionally used in physics and are really applicable to physics. If physicists have not used them, so much the worse for physics.

Dr. Wheeler sums up his discussion with a list of fourteen arguments in favour of vitalism—all those used by Driesch and several others. What is unsatisfactory about them is that they are all negative. They are designed to show that mechanism is not able to solve all problems and provide an all-sufficient philosophy. The mechanist might reply that he never said it did; he only claims that it suffices to supply all the useful information that has been or is likely to be obtained. There is no answer to this retort unless the vitalist can point to something positive on his side. Driesch's attempt was not a success because he hesitated between the old 'vital force' theory and the view that living organisms have minds, though perhaps very little ones. Neither view is necessarily absurd, nor if carefully interpreted need it contradict established facts or physical principles; but it is of no value unless it is consistently maintained, and applied in detail to specific cases.

The vitalist's demand for biology to use its own special methods and concepts can be readily granted, provided he can tell us what they are. A purely physical science like meteorology does this very thing. To-morrow's weather might be predicted by calculation using the general laws of thermodynamics and the kinetic theory of gases; but actually it is done by using purely *ad hoc* meteorological concepts and methods. If these concepts can be shown to be derived from the general theory of physics, so much the better; but if not, that is not a fatal defect. Similarly, if one wants to know the density of lead, the viscosity of glycerin or the structural formula of cane sugar, one does not find the values by calculation from the theory of atomic structure. Even if this were possible, it would take too long and give very inaccurate results. It may be suspected that results would only be forthcoming at all when the answer was known beforehand. The function of the general theory is merely to show that what has been accurately determined empirically is roughly the kind of thing that might be expected. In biology every investigator uses *ad hoc* concepts and methods while he is investigating, but as the concepts are difficult to define he may forget about them when he is arguing. For this reason, the Gestalt school of psychologists have done very valuable work in producing special concepts that are sufficiently well defined, can be applied to specific cases, and act as guides to experimental investigation. If as Kohler maintains, Gestalt principles are equally applicable to physics, that is a point in favour of Haldane's view. Dr. Wheeler probably agrees to all this, but he is not very explicit about it.

A. D. RITCHIE.

A USE FOR EVERY CHEMICAL

Uses and Applications of Chemicals and Related Materials

A Guide to the Current Industrial Uses, Potential Applications and Sales Possibilities of 5167 Products. Compiled and edited by Thomas C. Gregory. Pp. vi+665. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 60*s*. net.

THIS is a book for which many of us have been waiting. Whilst to the more academic among chemists individual chemical substances are mainly of interest on account of their properties, the elucidation of the finer points in their structure or for use in chemical reactions, there is also a large corps of chemists who, aided by engineers, technicians, physiologists and others, are engaged in finding a useful application of as many of them as possible to the better service of humanity.

The last decade has been outstanding in regard to the discovery that all sorts of what may be described as laboratory curiosities can be made to serve useful ends. Practical work of this nature requires a peculiar aptitude which is more common in the United States than in Britain. There also the willingness of the manufacturer to try something new, because it is new, encourages such developments. The point has often been emphasized in the columns of NATURE; perhaps its reiteration at a time when war emergencies are promoting invention will serve a useful purpose.

As the sub-title indicates, the book lists in alphabetical sequence a large number of substances which can be classed as chemicals, including a high proportion of synthetic organic materials. Against each substance is listed its uses, set out under industries again arranged in alphabetical order.

For some substances the uses are already numerous; with others they are limited. It becomes possible very quickly to see whether a use has been found for a particular substance and for what kind of purpose. Thus, turning over the pages at random, ethyltriphosphonium bromide may be used as an agent for moth-proofing furs, feathers and the like as well as textiles.

Montan wax has twenty-seven uses in such diverse industries as electrical, food, ink, leather, metallurgy, paint, paper, perfumery, rubber, textile, etc., all of which are set out succinctly.

Again, orthodichlorobenzene has been applied in freeing hydrochloric acid from arsenic, as an intermediate in making dyestuffs, as a cleansing and polishing agent for brass and as a solvent in all four very varied purposes.

The collection of the material was begun in 1922 by the late Ismar Ginsburg and was continued and expanded since 1933 by Thomas C. Gregory. Most of the data have been published in the *Oil, Paint and Drug Reporter* regularly since 1922, where supplementary surveys covering additional products and new uses will continue to appear.

The practical value of the book need not be further stressed; the only criticism from the point of view of the British reader is the high cost, which will restrict its circulation here.

E. F. A.

MATHEMATICAL METHODS IN ECONOMICS

Économie théorique et statistique économique (1) Théorie mathématique de la valeur en régime de libre concurrence. Par J. R. Hicks. Pp. 56. 18 francs. (2) Les fondements mathématiques de la stabilisation du mouvement des affaires. Par Prof. J. Tinbergen. Pp. 114. 30 francs. (Actualités scientifiques et industrielles, 580 et 632.) (Paris : Hermann et Cie, 1937–38.)

IN the classical economics of Marshall, it was assumed that a consumer spends his income so as to obtain the maximum possible 'utility', and it was deduced that the prices of commodities must be proportional to their marginal utilities. The weak point of this is that no one knows exactly what this utility is, and still less how it can be measured. Modern mathematical economists, in particular E. Slutsky, J. R. Hicks, R. G. D. Allen, have, by developing Edgeworth's 'indifference curve' and Pareto's 'scale of preference', succeeded in constructing a theory of value on a new and much sounder basis. All that is assumed is that the consumer knows, of the various sets of goods purchasable for a given sum, which he likes best, which second best, and so on. It is amazing how this apparently inadequate postulate is adapted to mathematical treatment, including the use of the differential calculus to determine the maximum satisfaction obtainable with a limited amount to spend.

Consider any set of numbers the order of magnitude of which indicates a consumer's order of preference without any pretence of measuring its magnitude. These form a function of u. The most general 'index of preference' is an arbitrary function of u. The marginal utility is also arbitrary, but the ratio of two marginal utilities has a definite value, as the arbitrary factor cancels out. This ratio is called the marginal rate of substitution, and is fundamental in the new theory. All the old work involving marginal utility can be employed, provided that the conclusions do not involve the arbitrary function.

One of the most important results is Slutsky's 'fundamental equation of the theory of value', which can be interpreted in terms of Marshall's elasticities. Further developments include the general equilibrium of exchange and of production ; but it is not necessary to describe these in detail, as the novelty of the work lies in its premises rather than in its conclusions. Prof. Hicks's tract is written for those with considerable mathematical attainments ; a comparatively non-mathematical account, with extensions to a much wider field, will be found in his "Value and Capital".

We now come to a more difficult branch of mathematical economics, dealing with the case when there is a time-lag between cause and effect. As a first approximation, Prof. Tinbergen makes a number of simplifying assumptions, such as that sales, profits and investments depend, not on the actual prices, wages and interest, but only on their mean values. Thus, in this 'macrodynamic approximation', production and prices are treated as a whole ; the variables are really index-numbers. Moreover, certain phenomena which are considered of minor importance, such as the excess of imports over exports, are entirely ignored. He now sets up a large number of equations, based partly on general economic ideas and partly on a careful statistical analysis of conditions in the United States (1919–1932). For example, one equation asserts that the mean price is proportional to the mean amount of sales nine months before, another that the rate of bank interest depends on the balance six months before.

In their general forms these equations are difficult to handle, but if we consider only variations from an equilibrium level, we get, with further approximation, a system of linear finite difference equations with constant coefficients, which are easy to solve. The solutions may be used for two purposes. First, they show how the conditions at a given period can be calculated from a knowledge of those at an earlier period. This is tested by a series of graphs, and the agreement between the calculated and observed results is much closer than might have been expected, in view of the extensive approximations made in the course of the work. Secondly, they show how the general nature of the solution depends on the values of the coefficients, and so how the magnitude of economic fluctuations can be diminished by Government action. Specific recommendations are drawn up for the consideration of the United States Government.

Lack of space compels us to pass over many extensions and applications of the author's method, such as the effect of external perturbations, of speculation, and of fixing salaries or prices. He gives a great deal of matter the importance of which may not be generally realized until it is available in a more extended form. But what seems most valuable is not so much any detail of the work as the general spirit. Physics and other sciences have made great progress because of the constant interaction between observation and theory, and it is likely that this method will prove equally fruitful in economics.

H. T. H. PIAGGIO.

SCIENTIFIC CENTENARIES IN 1940

BY ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

IN looking back once again for the names of men who were born or who died, one, two, three or more centuries ago, to whom the world is indebted for some discovery, or contribution of note to the progress of modern science, the first name which stands out clearly is that of William Gilbert, the physician of Elizabethan days. He was born in 1540. When sixty years of age he published his famous book "De Magnete, magnetisque corporibus et de magno magnete tellure". This was the first great work on physical science published in England. A century or so after Gilbert died, Dryden wrote the lines

"Gilbert shall live till loadstones cease to draw
Or British fleets the boundless ocean awe."

Gilbert was born at Colchester towards the end of the reign of Henry VIII. At the age of twenty he graduated from St. John's College, Cambridge. He afterwards spent some years in travel and study on the Continent and in 1569 obtained the degree of M.D. Four years later he settled in practice in London and ultimately became physician to Queen Elizabeth. His home was in St. Peter's Hill, and one of his haunts was the College of Physicians, then housed in Linacre's house in Knight-Rider Street not far from St. Paul's. He rose to be president of the College; and to it he bequeathed his books, globes and apparatus, but these were all destroyed in the Great Fire of 1666. He died at Colchester on November 30, 1603, and was buried in Holy Trinity Church, in which a monument was erected by his brothers.

Gilbert's experiments in magnetism and electricity mark an epoch in science in Great Britain. They were fully appreciated by some of his contemporaries and Galileo, in one of his "Dialogues", makes the imaginary Salviati say of the "De Magnete": "I highly praise, admire and envy this author for having formed such a stupendous conception on a matter which has been treated by many sublime intellects, but solved by none. . . . I do not doubt that in due course of time this new science will be perfected by new observations and by true and cogent demonstrations. But the glory of the first inventor will not be diminished thereby. . . ."

Another celebrated man of science who was born in 1540, and who died in 1603, was the French algebraist François Viète, commonly known as Vieta. Born at Fontenay-le-Comte, Vendée, he was educated for the law and for some time practised at the bar in Paris. When forty years of age he was given the post of master of requests, attached to the Parliament of Paris, and from that time he gave up his leisure to mathematics. Of the three books printed during his lifetime—for private circulation—the first was his "In Artem Analyticam Isagoge" (1591); this is the earliest work on symbolic algebra. In his article on Vieta, in the old "Penny Encyclopædia", the mathematician Augustus de Morgan wrote: "If a Persian or Hindu, instructed in the modern European algebra, were to ask 'Who of all the individual men made the step which most distinctly marks the separation of the science which you now return to us from that which we delivered to you by the hands of Mahommed ben Musa?' the answer must be Vieta."

Among the French mathematicians born a century after Vieta were Jacques Ozanam (1640–1717) and Phillippe de Lahire (1640–1718). The former wrote nearly twenty books, but he is remembered to-day for his four volumes of "Recreations Mathematiques et Physiques". The youngest son in a well-to-do family, Ozanam was intended for the Church. This prospect, however, had no appeal for him, and he became a teacher of mathematics at Lyons. He there appears to have developed a passion for gaming, but some time afterwards he removed to Paris and devoted himself entirely to mathematics and was elected to the Royal Academy of Sciences. It is said that when religious matters were being discussed he remarked "that it was the business of the doctors of the Sorbonne to dispute, of the Pope to decide, and of a mathematician to go to heaven on a straight line". His contemporary Lahire was the son of a court painter and it was hoped he would become one, but geometry proved too strong an attraction. In his thirties he began observing at the newly erected Paris Observatory where Cassini was similarly employed. By the Minister Colbert he was appointed to assist Picard in geodetical work for the chart of France. He wrote a variety of works and from 1690 onwards held a professorship in the famous Collège de France.

The year 1640 also saw the birth of Dr. Robert Plot (1640–96), author of natural histories of Oxfordshire and Staffordshire, a secretary of the Royal Society and the editor of vols. 143–166 of the *Philosophical Transactions*. When Elias Ashmole established the first University chemical laboratory at Oxford, it was placed under Plot's charge.

The bicentenaries which occur this year recall, among others, the names of two authors concerned with those indispensable works—encyclopædias. In May 1740 Ephraim Chambers died and was buried in the cloisters of Westminster Abbey. As a youth he had come to London from Westmorland to learn globe-making at the hands of Senex. From globe-making he turned to writing and, conceiving the plan for a dictionary of science, took chambers in Gray's Inn and there in 1728 produced his "Cyclopaedia, or . . . Dictionary of Arts and Sciences". It immediately won a reputation for him and he was elected F.R.S. Several editions of his work appeared and it formed the basis of the Cyclopædia of Dr. Abraham Rees (1745–1823). In between the publication of the encyclopædias of Chambers and Rees came that of the "Encyclopædia Britannica" (1771), projected, printed and published by the public-spirited Edinburgh printer and naturalist William Smellie, who was born the year Chambers died.

The record of scientists, inventors and pioneers born in 1740 includes the names of Henry Cort (1740–1800), whose patents of January 17, 1783, and February 13, 1784, for the production of wrought iron plates, bars and rods form a milestone in the history of our iron industry; of Joseph Michel Montgolfier (1740–1810), who with his brother Jacques Etienne Montgolfier (1745–99) made the pioneering experiments with balloons; of the astronomers Thomas Bugge (1740–1815) of Copenhagen, Jacques Andre Mallet (1740–90) of Geneva, Andre Jean Lexell (1740–84) of Sweden and St. Petersburg, and of the famous geologist, physicist and mountaineer, Horace Bénédict de Saussure (1740–99). Like Mallet, de Saussure long held a chair in the University of Geneva, but it was his travels, his observations of rocks and his climbing expeditions which contributed most to his renown. His excursions culminated during the years 1787–89 with the ascent of Mont Blanc, a stay for thirteen days on the Col du Géant, and a tour of Monte Rosa. Mont Blanc, it may be added, was first climbed in 1786 by the hunter Jacques Balmat and Dr. Paccard.

Some of the eminent men of science who died in 1840 were referred to at the anniversary meeting of the Royal Society of that year. Among these was the French mathematician Simeon Denis Poisson (1781–1840); the German anatomist and naturalist Johann Friedrich Blumenbach (1752–1840) and the German astronomer Heinrich Wilhelm Matthäus Olbers (1758–1840). Olbers and Blumenbach when they died had passed the allotted span of life, but Poisson, apparently by his unceasing labour and his neglect of exercise and healthy recreation, had shortened his life. From a boy upwards he had been a prodigious worker. He was a younger contemporary of Lagrange, Laplace, Fourier, Monge, Prony and other members of the brilliant group of scientists in Paris during Napoleonic and post-Revolutionary times. He occupied positions at the École Polytechnique, the Collège de France, and the Bureau des Longitudes. "If he was inferior to Fourier or to Fresnel," said an obituary in the *Athenæum*, "in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power: if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours".

Five others who died in 1840 were Joseph Johann von Littrow (1781–1840), the Bohemian astronomer who from 1821 was director of the Vienna Observatory; André Jean Francois Marie Brochant de Villiers (1772–1840), who with Elie de Beaumont and Dufrenoy made a geological map of France; Nicolas Aylmer Vigors (1787–1840), the Irish M.P. who was a founder and the first secretary of the Zoological Society; Sir Anthony Carlisle (1768–1840), the surgeon who with William Nicholson on May 2, 1800, decomposed water with the aid of the first voltaic pile made in England, and Sir Robert Seppings (1768–1840), an eminent naval constructor in the days of our 'wooden walls'.

Seppings was a shipwright apprentice in 1782, master-shipwright at Plymouth in 1800, and at Chatham in 1804, and in 1813 was appointed surveyor to the Navy, a post he held until 1832. He introduced a form of keel blocks for dry docks which enabled ships to be dealt with rapidly, and a system of diagonal trussing for ships which was extensively used. In 1818 he was awarded the Copley Medal of the Royal Society for his communications on warship construction. He died at Taunton on April 25, 1840, and his monument is in St. Mary's Church.

Of men of science born a century ago in Germany one of the most notable was Ernst Abbe (1840–1905) whose optical investigations, combined with the work of the instrument-maker Carl Zeiss (1816–88) and the glass-maker Otto Schott, made "Jena glass" famous the world over and Zeiss instruments the standard of excellence. Abbe was a professor in the University of Jena at the age of twenty-six he became associated with Zeiss. After Zeiss's death he was responsible for the business, which he formed into a sort of trust called the Carl Zeiss Stiftung. Speaking at the Optical Convention of 1905, shortly after Abbe's death, Glazebrook said that "Abbe's work in Jena is perhaps the most striking illustration of the way in which progress depends on the co-operation of science and experience". Another German physicist born in 1840 was Friedrich Kohlrausch (1840–1910), the successor of Helmholtz and the predecessor of Warburg, as president of the Reichsanstalt at Charlottenburg. In France 1840 saw the birth of Emile Duclaux (1840–1904), an early assistant to Pasteur, who after his master's death became director of the Pasteur Institute.

Sweden has long been famous for its chemists and metallurgists, and among the former are Lars Fredrik Nilson (1840–99) and Per Theodor Cleve (1840–1905). Both studied at Uppsala, both held chairs there and at Stockholm and both were elected foreign members of the Chemical Society. The memorial lecture to the Society on Nilson was given by Prof. Otto Pettersson and that on Cleve by Sir Edward Thorpe. Speaking of the position Sweden occupied in relation to chemistry, Thorpe said that "when regard is had to her position among continental nations—to her chequered political history, to her geographical isolation, the comparative sparseness of her population, her relative poverty, the fewness of her seats of learning—the influence which Sweden has been able to exert on the development of that branch of science, which it is the proper function of this Society to foster, must always excite our wonder, admiration and gratitude. The mere mention of the names of Bergmann, Scheele, Berzelius, Mosander, Gadolin, Nilson, is sufficient to remind us how great have been her services to the science of chemistry".

To this necessarily incomplete list of men distinguished in science, invention or engineering may be added the names of the American geologist Edward Drinker Cope (1840–97); the American-British inventor and engineer Sir Hiram Stevens Maxim (1840–1916); the Irish astronomers Lord Rosse (1840–1908) and Sir Robert Stawell Ball (1840–1913); the Scottish inventor John Boyd Dunlop (1840–1921) of pneumatic tyre fame; the English metallurgist James Riley (1840–1910), and the great civil engineer Sir Benjamin Baker (1840-1907), whose name will always be remembered in connexion with the Forth Bridge, the Aswan Dam and other important constructions. Baker was elected F.R.S. in 1890, and served as president of the Institution of Civil Engineers in 1895. He died at Pangbourne on May 19, 1907, and was buried at Idbury, in the Cotswolds. On December 3, 1909, a memorial window to him was unveiled in the north aisle of the nave of Westminster Abbey.

FOOD FROM GARDENS AND ALLOTMENTS

BY SIR JOHN RUSSELL, F.R.S.,
ROTHAMSTED EXPERIMENTAL STATION

THANKS to numerous official inquiries, the quantities of food required by the population of Great Britain are fairly well known. Our diet is both generous and varied. The total food consumption averages rather more than 900 lb. a head without counting milk and eggs. Apart from these the *per capita* consumption falls into five groups: about 200 lb. each of (1) wheat, (2) potatoes, (3) other vegetables and fruits, and (4) meat and fish combined; (5) some 140 lb. of other foods, chiefly sugar (94 lb.) with smaller quantities of butter (25 lb.), margarine (8 lb.) and cheese (10 lb.).

We produce at home all the potatoes, the liquid milk, and much of the vegetables; about half the meat and fish, but only 15 per cent of the wheat and some 10 per cent of butter. We produce rather less than 40 per cent of the total money value of our foods, and rather less than 50 per cent of the total weight. On an average, for each individual there is in peace time an import of about 4 cwt. of food per annum.

One of the most urgent problems at the present time is to reduce this figure. It is made up roughly as follows:

Wheat	1½	cwt.
Meat and fish	1	"
Fruit, butter, cheese, etc. ..	1	"
Sugar	60	lb.
Total	4	cwt. approximately

The largest item is wheat, of which 170 lb. is imported out of the 200 lb. consumed. We shall, however, produce more. The plan of the Ministry of Agriculture is to plough up two million acres of land in all; in the War of 1914–1918, when this was nearly accomplished, we had added 50 per cent to our wheat production.

If we succeed in doing as much this time, we shall reduce the 170 lb. of imports to 155 lb., but it seems scarcely likely that we can get much below this. Something could be saved by closer milling, but that would only mean less food for our animals and therefore less meat and milk. For one thing we have insufficient land available:

wheat is one of the least economical of all crops to grow so far as land is concerned, for while 1 acre of wheat suffices only for 6–7 persons per annum, 1 acre of potatoes suffices for 70–75.

For meat and fish our imports are about 110 lb. annually out of a total consumption of practically 4 lb. per week per head. Consumption could be cut down by rationing; but in view of the circumstances that our animal population is now larger than it has ever been before, it seems improbable that there will be much shortage during the first year of the War. Even our animals, however, have been living on imported food, though not to the same extent as ourselves; Dr. Wright recently estimated that some 25 per cent of their total food is imported.

The area of land being limited, all increased allocation of land for human food means a reduced area for the growth of food for animals. During the War of 1914–1918 the annual production of milk fell by 400 million gallons, a reduction of 20 per cent, while that of meat fell by 170,000 tons, a reduction of 17 per cent. There were various contributory causes and we shall hope in this War that the fall will not be so great. In seeking to increase production of human food we must not, however, forget our animals.

The import of fruit will be difficult to replace. The Englishman's favourite fruits are bananas, oranges and apples, and two of these must be wholly imported while of the third we produce only a fraction of our total consumption.

Another big item in the import bill is sugar; the 60 lb. of import can be cut down by rationing; we can produce more at home than we are doing and we shall, it is hoped, also make better use of bees. From a reasonably well-kept hive one should obtain some 40 lb. of honey, though this is not a net gain because it involves the feeding of some 10–20 lb. of sugar to the bees. On dairy produce we cannot hope to save much. If there were no waste the ration of ¼ lb. of butter per week would give us 13 lb. a year, not far short of the 16 lb. which was our average until recently.

The most hopeful direction of saving shipping is therefore to economize on meat, fruit and sugar, at the same time increasing our home production of wheat and also of animal food so as to avoid the necessity for reducing home production of milk and of meat.

The question to be decided then is: What part can gardens and allotments play in this programme of production?

Experience in the War of 1914–18 shows that production of potatoes can be readily expanded and with great advantage in every way. The production rose in the last war from 7·5 million to 9·4 million tons—an increase of nearly 25 per cent. Potatoes are not only valuable as food for men and for animals; they are also an important source of starch for various other purposes. They are easy to grow and responsive to treatment.

Vegetables will become of increasing importance as the meat ration is cut down; but unfortunately, while the English gardener can produce them at least as well as anyone else, the English cook usually treats them deplorably. The great difficulty about reducing our meat ration will be that we may be presented with a succession of vegetarian dishes, made dull and tasteless, not through any fault of the vegetables, but because of the incompetence of the cook. For this reason it is very important in any garden or allotment that there should be as wide a variety as possible of vegetables, including particularly those used for salads, and those that can be made up into tasty dishes. Food value is probably of less importance than tastiness; it seems improbable that our dietary would ever be so seriously curtailed as to be lacking in actual food value; the present danger is that it may lack variety and no longer be appetizing. This the gardener should seek to remedy.

It seems inevitable that sooner or later we must face a reduction in the amount of fruit that we usually import; we can scarcely hope to continue our present supplies of oranges and bananas and imported apples. In many gardens there are fruit trees and bushes in a more or less neglected condition. If these were overhauled they might be made to yield better during the coming season; the produce may be very welcome, for the deficiency of fruit must somehow be made good both by growing more at home and by using more vegetables.

The increased garden production of potatoes and vegetables would have several important advantages quite apart from ensuring supplies for the grower's table. Farm land now used for the production of potatoes and vegetables could be released for other purposes, especially for the production of fodder crops for animals, thus saving the necessity for uneconomic slaughter and ensuring continued milk and meat production.

Much internal transport could also be saved. At the present time many parts of Great Britain are not self-supporting in potatoes and vegetables, and considerable quantities have to be transported from county to county, occupying valuable truck space or using up petrol on the roads. It would be a great advantage if this internal transport could be cut down.

The possibilities of increase are considerable. It is estimated that there are some 3½ million gardens and 900,000 allotments in the country. The Ministry of Agriculture is stimulating the formation of new allotments, aiming at establishing another 500,000. Many of the existing gardens and allotments are not, however, fully used, and it is desirable to improve them as speedily as possible. Technical advice is now available in every county. There is, however, a real danger of considerable waste of seed and manure, neither of which can well be spared now. Here there seems a useful opening for local distribution that could ensure distribution of manure and interchange of seedlings so as to avoid the present wasteful methods. Distribution of excess produce is another important problem, for however well the garden is planned it is impossible to avoid an excess at one period and a deficiency at another. Unfortunately, organization of garden production is peculiarly difficult and in the past has rarely succeeded, but that is no reason why it should not again be attempted, as in the last war. Finally comes the important question of utilization of garden wastes; the best way, the keeping of pigs and poultry, is not usually possible. In any event, even if these are kept, the compost heap is an essential part of a good gardener's equipment.

THE EARTHQUAKE IN TURKEY

By E. Tillotson

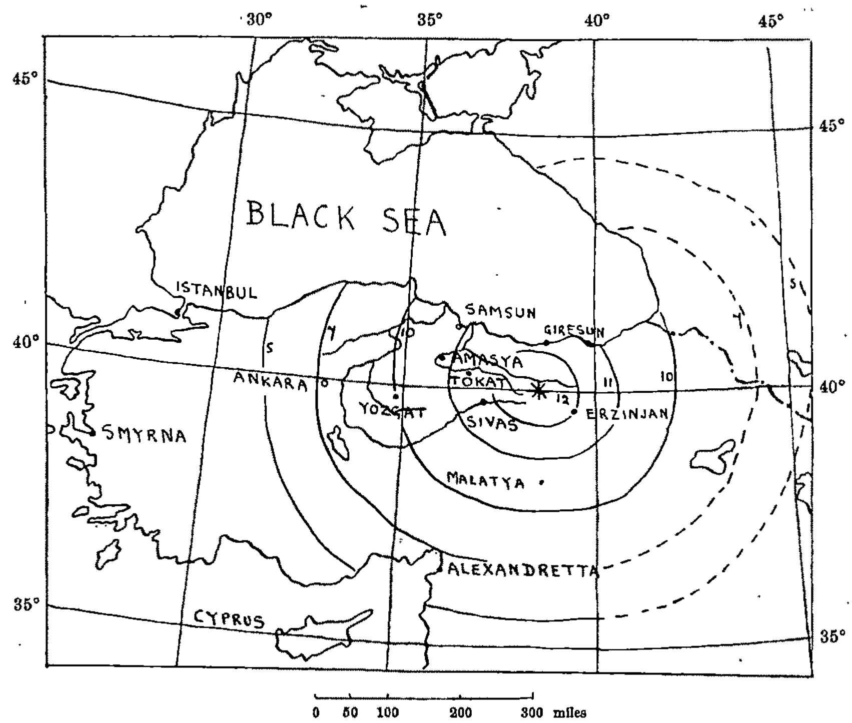
THE greatest earthquake ever recorded in Turkey, and probably the greatest natural catastrophe which Turkey has ever suffered, occurred on December 27, when, between approximately 1.57 a.m. and 5 a.m. local time (East European), there were at least seven terrific earthquake shocks. These shocks caused havoc on and near the Black Sea coast of Anatolia in north-eastern Turkey, where, to the accompaniment of underground rumbling, upwards of fifteen towns having populations of between fifteen and forty thousand persons each, together with more than ninety villages, were practically razed to the ground, communications by telegraph, road and rail destroyed, and estimated casualties of 45,000 killed and 20,000 wounded caused.

The first news of the catastrophe was received from the Bendandi Observatory at Faenza, which reported that an earthquake of catastrophic dimensions was registered on its seismographs at 1 a.m. (Mid-European time). The earthquake was estimated to have taken place in Armenia, and the vibration at Faenza was so intense that the recording instruments were damaged. Similar news came from the Swiss observatories, and at Zurich the shock was received at 1.2 a.m. (Mid-European time). The seismograph belonging to Mr. J. J. Shaw at West Bromwich was also damaged by the earthquake, though Mr. Shaw was away from home at the time. Shortly after the news from Faenza, messages were received from Ankara stating that earthquake shocks had been experienced there.

The full force of the principal shock was felt at Erzinjan, a town situated at an altitude of 4000 ft. above sea-level where a brisk trade was conducted in silks, cotton and copper. The town was immediately reduced to a heap of ruins and about 80 per cent of the population killed. The upsetting of oil lamps and stoves and the breaking of gas pipes caused hundreds of fires to break out in all parts of the town, which the surviving brigades could not extinguish on account of broken pipe lines and huge cracks in the roads. Telephone and telegraph communications were also disrupted. Here, included in the wreckage, were the military barracks and club and military school, where ten officers and ninety cadets are known to have lost their lives, though a much greater military death roll is feared. Damage only a little less severe was done at many other towns. Sivas, a town of 65,000 inhabitants, the centre of caravan routes and a collecting place for the agricultural produce grown in the surrounding districts, together with Tokat in Sivas Province, a town of 31,000 inhabitants engaged largely in calico manufacture, and the intervening villages, were practically wholly destroyed. Many people, in bed at the time of the first shock, were buried alive in the wreckage of their homes. The district of Kemah, the town of Yozgat and the town of Amasya, with a population of 30,000, in the midst of fruit-growing country, are all in ruins. At Samsun in the Trebizond district, a seaport with a population of 15,000, exporting copper, timber, tobacco, wool and other agricultural products, mosques, minarets, schools and public buildings—some of them built of reinforced concrete—and private houses came crashing down, killing thousands of people. Ordu, in the tobacco-growing district, suffered similarly, as did also Giresun, Malatya, Turhal, Gumushane, Refahive and Plumer. On the night of December 28 fires were still blazing amidst the ruined buildings, and to add to the difficulties of the rescue parties a blizzard was raging in the countryside at a temperature of 2° F. Of the 350 inhabitants of the village of Tomruk, only three survivors have been traced. The single-storied mud houses of the peasants suffered terribly.

The first relief train on the recently opened Sivas-Erzerum railway was held up just outside Sivas because of wreckage on the line, twisted rails and huge ground fissures. Most of the geological faults already known in the area have moved, causing large crevices and permanent lateral movement. One of the principal faults along which movement has taken place has been estimated by the director of the Istanbul Observatory to be sixteen miles deep, and many new faults have been formed.

On the basis of the macroseismic data, the accompanying sketch map showing the isoseismal lines has been constructed. The scale used is the modified Mercalli scale of 1931 originated by H. O. Wood and F. Neumann for the Carnegie Institution of Washington and the United States Coast and Geodetic Survey. This scale is numbered 1–12 in ascending order of earthquake intensity, 1 being a shock not felt except by a very few under especially favourable conditions, and 12 being a shock where the damage is total, waves being seen on ground surfaces, lines of sight and level distorted and objects thrown upward into the air. It is extremely rare for a shock to have intensity 12, though many of the great earthquakes described by Davison, and the Chilean earthquake of January 24, 1939 (NATURE, February 11, 1939, p. 230), probably exceeded scale 11, which indicates that few if any masonry structures remain standing, broad fissures exist in the ground, underground pipe lines completely out of service, and rails bent greatly. Scale 7 indicates that damage has been negligible in buildings of good design and construction but considerable in poorly built or badly designed structures, whilst scale 5 shocks are felt by nearly everyone, break some dishes, crack some plaster and overturn unstable objects. It should be noticed that such intensities are influenced by ground conditions as well as by the energy causing the displacements, and, since buildings once cracked may succumb to prolonged shaking, the total period of shaking would appear to be an important factor.



SKETCH MAP SHOWING THE APPROXIMATE EPICENTRE AND ISOSEISMAL LINES (MODIFIED MERCALLI SCALE OF 1931) OF THE ERZINJAN EARTHQUAKE OF DECEMBER 27, 1939.

*, EPICENTRE ; —10—, ISOSEISMAL LINE.

The greatest of the shocks was certainly world-shaking so far as modern seismographs are concerned, since these are capable of registering measurable ground displacements of less than 5 μ (where $\mu = 0{\cdot}001$ mm.). It was registered at observatories throughout the British Isles and in the world in general. The fact that seismographs as far away from the epicentre as West Bromwich which were set for normal earthquakes were dislocated appears to show that the surface waves L and M as distinct from the body waves P and S were of very large amplitude, indicating the release of a tremendous amount of energy from a normal or shallow focus. This also appears to be confirmed by the relatively quick decrease of destructiveness in all directions moving away from the epicentral area. The news from Istanbul Observatory also appears to indicate that the greatest focal depth of any one shock was sixteen miles.

The principal shock is estimated to have shaken the devastated area for a period of some twenty seconds, though seismograms from distant observatories occupy a much longer period of time on account of the variation in velocity of the different waves sent out by the earthquake. The epicentre of the principal shock appears to have been near latitude 40° N., longitude 38·5° E. and the initial time of the first shock about 1.57 a.m. local time (East European) or 26d. 23h. 57m. G.M.T. It must not be thought that all the seven or more shocks originated at the same time or from the same epicentre, as there is evidence to support the hypothesis that the epicentres of the shocks wandered east and west along latitude 40° N., the first being some seventy miles east of Ankara, and later southwards along approximate longitude 39° E. Also it appears to be more correct to speak of an epicentral area rather than an epicentrial point. Aftershocks have continued to be numerous and severe. These, too, appear to be peripatetic along the lines above mentioned, and as yet the diminution according to the usual exponential law does not seem to have become evident. Shocks were still occurring up to December 31, and on that date a violent shock was reported at Bergama, on the Ægean coast.

On December 31, serious floods followed the earthquakes. These have caused further casualties and damage to houses and communications. It is now estimated that the entire population of Erzinjan, Trebizond, Tokat, Sivas, Ordu, Samsun and Amasia, totalling about two millions, are without shelter.

More than five hundred villages in the Brusa region have become marooned, and the Izmid Gulf area is totally submerged. Intermittent, though less intense, shocks occurred in eastern Anatolia on January 1. On the same day, the towns of Karacabey, Manyas and Yenisehir became inundated by the flood water, and the Rivers Nilafur, Halife and Karadere changed their courses. More villages were marooned later in the day.

It is estimated that the devastated area covers about 15,000 square miles, which is about one twentieth of the country.

A third disaster occurred on January 1, when severe storms broke out over the Black Sea causing serious damage to shipping.

On January 2, the floods became more extensive in western Anatolia, where the Sakarya River overflowed and flooded the Bilecik valley. Light tremors were still occurring.

It has been noticed previously by Dr. C. Davison and the late Prof. H. H. Turner that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world and often at the antipodes. It may be that at these places where sympathetic earthquakes occur there already existed a state of tension (or compression) in the strata and 'layers' which almost amounted to unstable equilibrium, and that it only needed the trigger action of another shock in lieu of some other factor to release the energy and produce the sympathetic earthquake. The Anatolian shock was particularly violent, and therefore it was no surprise to find earthquakes occurring in other parts of the world. On December 27 about 7 a.m., San Salvador in Central America, near to which there was an earthquake on December 5, experienced earthquake shocks, as did Los Angeles in California on the same day. These are both reported to have been strong shocks, though no damage was reported. Between December 27 and 28, twenty-five earthquakes and earth tremors, two of which were of sufficient intensity to rattle crockery though none did any material damage, shook the gold-mining district of the Rand near Johannesburg in South Africa. On December 27 also, at Tangier, the north African port, deaths were reported as being due to a strong earthquake there. Previously, in 1784, Erzinjan was devastated by a severe earthquake, though the shock does not seem to have been so severe as on the present occasion.

It must be remembered that the whole of Asia Minor is a seismic zone for small shocks, as is seen by the fact that Miss Bellamy has catalogued 280 shocks as having occurred in and around Turkey between 1913 and 1930, though earthquakes in this region appear to have been stronger and more numerous of late (prior to the present shock). On September 22, 1939, two hundred people were reported killed during an earthquake which occurred in the Smyrna district (NATURE, September 30, p. 589). Damage and casualties occurred also in the villages of Pergame, Kotchili and Fotcha. Then so recently as November 23 last, an intense shock destroyed six villages in Anatolia (NATURE, December 2, p. 938), killing forty-three people besides injuring many more.

Further news of the present disaster must await the restoration of communications in the afflicted area, and the careful study of the seismograms in observatories throughout the world.

THE PALAO TROPICAL BIOLOGICAL STATION

BY PROF. C. M. YONGE,
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THE history of the investigation of coral reefs reveals the fascination these unique marine communities have exercised over the imaginations of zoologists. One thinks of Darwin at Cocos Keeling, of Dana on the United States Exploring Expedition, of Murray on the *Challenger*, of Alexander Agassiz who sailed over all tropical oceans, of Gardiner and Sewell in the Indian Ocean, of Mayor at the Tortugas and at Murray Island and Samoa, of Crossland in the Red Sea and in Tahiti. In more recent years exploration and description have given place to studies of a more physiological nature, and research has been localized around permanent or temporary marine laboratories. Mayor led the way at the Tortugas and was followed by the Dutch at Batavia, by the Great Barrier Reef Expedition at its temporary laboratory at Low Isles and by the University of Egypt on behalf of which Crossland established the marine laboratory at Ghardaqa in the Red Sea.

Now a new centre of research has been established by the Japanese on Korror Island, one of the Palao (Pelew) group situated in the western Pacific some eight degrees north of the equator. The Palao Tropical Biological Station owes its inception to the activities of the Japanese Society for the Promotion of Scientific Research, the site of the station being selected by Prof. Shinkishi Hatai of the Tôhoku Imperial University, Sendai. The Laboratory, which was opened in April 1935, consists of a series of single-story wooden huts admirably suited for work in the tropics. It is surrounded by water which varies in temperature only between 28° and 31° C. and is rich in coral. Since its establishment a continuous stream of biologists have been sent to the Station from Japan and the results of their work are contained in the pages of the *Palao Tropical Biological Station Studies*, the first volume of which has recently been completed.

The most important sections of this work are concerned with corals. No fewer than 116 species, belonging to 43 genera, have already been identified, and these are listed in a systematic paper by M. Eguchi. This number compares with 117 species of 41 genera recently reported by Umbgrove[1] from the Bay of Batavia, probably the scene of the most intense collecting in the tropical Indo-Pacific.

Dr. Noboru Abe, of the Asamushi Marine Biological Station, contributes a series of papers dealing with the unattached coral, *Fungia actiniformis* var. *palawensis*. The eggs are fertilized while still in the gonad and therein develop into planulæ. These are liberated about the time of new moon every month from September until April, a condition which recalls the similar regular planulation of *Pocillopora bulbosa* recorded by Marshall and Stephenson at Low Isles[2]. Post-larval development is described and figured, the animal being capable of capturing active copepods about the fifteenth day. In a later paper the feeding reactions and nematocysts of this and fifteen other species of corals are described. Valuable observations on tentacular and ciliary feeding are recorded, the general conclusions supporting those of Yonge[3] that corals are specialized carnivores feeding on zooplankton. Ecological studies revealed that this species is widely distributed in regions of still water on sandy areas where it is frequently aggregated in large numbers together. Abe analyses the causes of this distribution in a paper dealing with migration and righting actions. He confirms the observations of Marshall and Orr[4] that Fungia is capable of uncovering itself when buried under sand while he also reveals that it can right itself when turned over. This reaction, as well as uncovering, are due to expansion of the disk tissues high above the underlying skeleton. The same phenomenon has been recorded by Yonge[5] in *Maeandra areolata*, the unattached meandrine which occupies a similar habitat in the Atlantic. The aggregation of Fungia is explained by the action of tidal currents which carry them into areas of still water where sand collects between coral patches. Work on the biology of these unattached corals reveals the great powers of adaptation possessed by Madreporaria.

Abe also describes the expansion and contraction of the polyps of *Caulastrœa furcata* which, like the great majority of reef-building corals, expands only by night. Expansion has no relation to food, zooplankton supplied by day failing to induce it. Abe associates expansion by night with the greater need for diffusion of carbon dioxide when this is not removed by the photosynthetic action of the zooxanthellæ. He found that expansion occurs by day when oxygen tension is low and that of carbon dioxide is high. But actually it is contraction during the daytime—a condition not found in the other Anthozoa—which requires explanation, not expansion by night. Nevertheless Abe has broken new ground in this work which will contribute to the eventual solution of this problem.

In a series of papers on the physiology of reef corals Kawaguti confirms the observations of Yonge, Yonge and Nicholls[6] on the oxygen consumption of corals in relation to its production by the zooxanthellæ, and adds important data on the effect of light on pigmentation and growth. Upward growth of corals is all-important in the formation of reefs, and Kawaguti states that all reef-builders containing zooxanthellæ which he examined showed positive phototropism. The presence of glycogen, small amounts of a reducing sugar and copper in Fungia has been determined by Hosoi. Hayasi has entered the controversy concerning the mode of formation of the skeleton and decided that the calicoblasts are the ectodermal cells themselves, not specialized cells derived from these, which secrete the calcareous lamella, including the organic matrix, as an extracellular product. Other papers deal with animals associated with corals, and include observations by Hiro on the gall-crabs, Hapalocarcinus and Cryptochirus, and on cirripedes which grow on corals. A long paper by Matsuya is concerned with the hydrography and plankton of the waters of Iwayama Bay.

Enough has been said to reveal the range and interest of the work being carried out at the Palao Tropical Biological Station. The work of Prof. S. Hatai has long been known in connexion with his direction of the Asamushi Marine Biological Station and the numerous papers published by him and by his pupils in the Science Reports of the Tôhoku Imperial University. He is sincerely to be congratulated on the work of this new tropical marine station which he instituted and the activities of which he has since directed with such conspicuous success.

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[1] "Zool. Mededeelingen", Leyden, 22 (1939).

[2] Sci. Rpt. G. Barrier Reef Exped., 3, No. 8.

[3] Sci. Rpt. G. Barrier Reef Exped., 1, Nos. 2 and 3.

[4] Sci. Rpt. G. Barrier Reef Exped., 1, No. 5.

[5] *Pap. Tortugas Lab.*, 29, 187 (1935).

[6] Sci. Rpt. G. Barrier Reef Exped., 1, No. 8.

OBITUARIES

Prof. Ernest A. Gardner

THOUGH unable latterly to take active part in the studies to which he had contributed much, Prof. Ernest Gardner, who died on November 27, aged seventy-seven years, will be remembered in the University of London as the creator of a vigorous department of classical archæology, and as a stimulating teacher, as well as for his administrative services as Dean of the Faculty of Arts (1905–9 and 1913–15), and as Vice-chancellor in 1923–26. After a distinguished Cambridge career, he went out to Greece in 1886 with a fellowship of Gonville and Caius College, and a Craven Fellowship, as the first student of the newly founded British School of Archæology at Athens, of which he became director in the following year. He had already done a season's excavation at Naucratis with Flinders Petrie and Griffith, and took a leading part, with Montague James, Hogarth, and the present Rector of Lincoln College, in work at Paphos for the Cyprus Exploration Fund. Under his management, the British School soon took recognized place among other foreign institutes in Athens, and began to form the long series of explorers, excavators, and teachers at home, which has continued until the present time.

In 1896 the Yates professorship of archæology at University College, London, fell vacant, and gave Gardner a congenial opportunity. Here too he had to begin with the foundations, and secure for his subject a place in the curriculum. His best-known book, a "Handbook of Greek Sculpture", was published in the same year, and at once became the recognized English text-book: later it was supplemented by a more detailed study of "Six Greek Sculptors". In 1897 appeared his "Catalogue of Vases in the Fitzwilliam Museum", and in 1905 he supplemented the "Introduction to Greek Epigraphy" of E. S. Roberts, the Master of his own college, with a volume on the inscriptions of Attica. Of more general (and in the best sense popular) quality was his description of "Ancient Athens" (1902), published at a moment of pause after rapid and varied discoveries, when it was possible for one who knew the ground as Gardner did to present the results as a comprehensible whole, in the lucid style and with the fine scholarship which marked all his writing.

In the War of 1914–18, though over military age, Gardner put his intimate knowledge of Greece and the Greek people at the disposal of the Admiralty, and as a lieutenant-commander in the Royal Naval Volunteer Reserve, did valuable service at Salonica; in leisure moments bringing together at the White Tower the numerous antiquities found in the British trenches and within the lines. Of these the most conspicuous was a huge Roman milestone, whose inscription beginning *Kaisari Germanico* caused some mirth among the rank and file.

Returning to London, Gardner found many distractions in university affairs, but continued to publish useful books on ancient life and art in Greece, and to take an active part in the proceedings of the Hellenic Society, of the *Journal* of which he had been editor from 1897, while from 1929 until 1932 he was its president. A characteristic and memorable contribution to classical studies was his series of cruises for students of all ages, undertaken when such facilities were rare and not easy to arrange; they brought him into personal contact with a wide variety of acquaintances, and opened what was then a new aspect of classical study.

J. L. MYRES.

Prof. V. R. Williams

WE learn with deep regret of the death of Prof. Vasili Robertovich Williams, professor of soil studies in the Timiriazev Academy of Agriculture, and well known to soil investigators for his important contributions to agricultural science.

Williams was born in Moscow in 1863, the son of an American constructional engineer who had settled in Russia in 1854 and married a Russian lady. He studied at the old Petrovsky Academy of Agriculture and Forestry, to which after a period of postgraduate work in Paris with Pasteur, he returned as lecturer. In 1894 the Institute was replaced by the Agricultural Institute of Moscow and he was appointed assistant professor of soils and agriculture. In 1906 he became director of the Institute, and after the Revolution, when it was reorganized as the Timiriazeff Academy of Great Socialist Agriculture, he was again made director though afterwards a political head was chosen in accordance with the policy then prevailing.

From the outset, Williams's soil work centred around the organic constituents: he never lost his interest in these. Only last August he showed me a colourless crystalline organic substance which he had extracted from the soil and to which he attached great importance. Like other Russian soil workers after the Revolution, he did a good deal of soil surveying and he acquired an extensive knowledge of soil utilization and crop production in Russia. On the applied side his most important activity was his keen advocacy of grass leys in the rotation. Russian agriculture was, until recently, mainly based on variants of the old three field system, fallow, winter corn, spring corn. Williams knew how greatly the agriculture of Western Europe had improved when a clover or grass and clover crop was inserted between the corn crops, and he strenuously urged that this should be done in Russia. The coming of collectivization gave an opportunity for a change of system, and the need for increasing the animal population after the devastating losses of livestock at first incurred furnished the justification for strenuous efforts to ensure ample production of fodder crops. So Williams used all his great influence in the U.S.S.R. to extend the culture of grasses and clovers and showed that, not only would more cattle food be produced, but also the soil fertility would be increased and the danger of erosion lessened.

In his later years, Williams devoted much time to the building up of his soil museum, and on each of my recent visits to the Institute he personally demonstrated its chief features: it included a large number of typical profiles with specimens or illustrations of the flora native to each type, and charts showing the most suitable kind of agriculture.

His soil work is described in his book, "Soil Science", first published in 1914 and revised in 1920.

Williams was afflicted with a paralysis which impeded his activities but never damped his enthusiasm. Like others of the older school of Russian scientific workers, he had a good knowledge of a Western language so that conversation and discussion were always easy. In his case the language was English, learned from his father and never forgotten. His work was much appreciated in Russia and he was given the highest awards open to Soviet citizens: the Order of Lenin, a seat in the Supreme Soviet, and membership of the Academy of Sciences; more important still, the deep respect, softened by affection, of many past students now engaged in agricultural organization in Russia. One of the pavilions of the great agricultural exhibition at Moscow is adorned with a very large mural painting showing him at work in his department.

E. JOHN RUSSELL.

Mr. G. Eumorfopoulos

WE regret to record the death at the age of seventy-six of Mr. George Eumorfopoulos, which took place on December 19. Eumorfopoulos had long been known as a great collector and skilled connoisseur of objects of Oriental art and more especially of the art of the Chinese.

George Eumorfopoulos was born in Liverpool in 1863. Until 1934 he was a member of the well-known firm of Ralli Bros. His career as a collector began with English and Continental porcelain, but he soon turned to Oriental art, and was one of the first collectors to give special attention to pieces of the earlier Chinese dynasties—Chou, Han, T'ang and Sung. In this field his collection for the beauty, rarity, and historic and archæological value of the specimens it contained, ranked among the greatest in the world. It was thrown open with the greatest liberality to students, fellow-collectors and connoisseurs from any and every part of the world without distinction beyond interest in that field, which Eumorfopoulos by the judicious use of his wealth in the service of his knowledge and his artistic judgment had made peculiarly his own.

Above everything Eumorfopoulos was anxious that so far as was possible others less fortunate than himself should share in the advantages for study that he enjoyed. A type collection of Chinese porcelain was formed by him and presented to the Museum at Athens, and his gifts to other museums were both numerous and valuable; but his greatest sacrifice was unquestionably the sale of his collection as a whole, which through his generosity in accepting a price far below its pecuniary value, became the property of the British nation in 1935. Now, though divided, it forms by far the most important part of the material available for the study and appreciation of the art of the Far East in the national collections.

Eumorfopoulos was also a generous supporter of all forms of archæological investigation, but more especially if it showed likelihood of advancing knowledge of the history of art. As Sir Leonard Woolley has recalled, he was a generous contributor to the funds for the excavation of Ur; and a visit to the site of the excavation was one of the few occasions on which he travelled in the East. Another which afforded him an even greater delight than that he experienced in Mesopotamia was when in 1935 he travelled in China with R. L. Hobson of the British Museum to help in selecting exhibits for the International Exhibition of Chinese Art held in London in the following winter. The welcome he then received in China was such as befitted his eminence as a collector and expert, and was in a sense the crowning reward of his career.

WE regret to announce the following deaths:

Prof. Czeslav Białobrzeski, professor of theoretical physics in the University of Warsaw, recently executed by the German authorities in Poland, aged sixty years.

Sir John Withers, M.P., who has represented the University of Cambridge in Parliament since 1926, a former president of the Alpine Club and member of the Mount Everest Committee, on December 29, aged seventy-six years.

Prof. Hans Ziemann, professor of internal medicine in the University of Berlin, aged seventy-four years.

NEWS AND VIEWS

Seventy Years Ago

ON November 4, 1869, the first issue appeared of a new "weekly illustrated journal of science" entitled NATURE. It was under the able and forceful editorship of Sir Norman Lockyer, who secured the support of the leading men of science of the day for the new venture. Turning back in thought to those days, it will be seen that there is a certain parallelism between world affairs of that time and the present international situation. Prussia had defeated Austria and its German allies, and had emerged as a leading European power. Strategic railways had been built to the eastern and western frontiers, and tension between Germany and France increased until in July 1870 war was declared. The campaign was relatively short, but its consequences were momentous and have determined much of the history of the past half-century. It seemed worth while, therefore, to turn back to the early pages of NATURE, to note the reaction of scientific men and affairs to the course of events, and to observe the progress of science as recorded week by week in this journal. Let this be sufficient reason for the column of quotations and notes, taken from the first number of NATURE to appear in 1870, which is printed elsewhere in this issue (p. 41). It is proposed to publish week by week similar extracts from the issues of NATURE of "seventy years ago", in the hope that scientific workers will derive both profit and pleasure from these contemporary accounts of scientific thought and events.

Royal Meteorological Society: Symons Gold Medal

THE decision of the Council of the Royal Meteorological Society to award the Symons Gold Medal for 1940 to Dr. J. Bjerknes will be very popular among British meteorologists, to whom he has become well known during his frequent visits to this country. In 1932 the Medal was awarded to his father, Prof. V. Bjerknes, and it is fitting that the son, who shared the work, should also share the honours. Dr. J. Bjerknes is well known for his numerous and penetrating memoirs on the structure of barometric depressions and on the mechanism of the atmospheric circulation. Among his earlier papers we may mention "On the Structure of Moving Cyclones" (1919), and (with H. Solberg) "Meteorological Conditions for the Formation of Rain" (1921), and "The Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation" (1922) in which he laid down the principle of 'cyclone families' and emphasized the role taken by depressions as an integral part of the exchange of air between high and low latitudes.

Later, while temporarily on the staff of the British Meteorological Office, Dr. Bjerknes compiled "Practical Examples of Polar-Front Analysis over the British Isles in 1925–6", published as Geophysical Memoir No. 50, and he has since analysed in great detail, on the bases of both surface and upper air observations, a number of depressions presenting special features. In 1933 the accumulated research of the Norwegian school of meteorologists into the dynamics of the atmosphere was published in book form under the title "Physikalische Hydrodynamik" by V. and J. Bjerknes, H. Solberg and T. Bergeron. Dr. Bjerknes is still young, and we look forward to further important research in future from these brilliant Norwegians.

University of Oxford: Chair of Forestry

MR. H. G. CHAMPION has recently been appointed to fill the chair of forestry at Oxford in succession to the late Prof. R. S. Troup. Mr. Champion graduated at Oxford with first-class honours in chemistry and botany. He went out to India in the Forest Service in 1915 and was posted to the United Provinces. After successful work in divisional and working plans posts he was selected for appointment as sylviculturist at the Forestry Institute at Dehra Dun. In this post he carried out some notable work. Perhaps Mr. Champion's most important contributions to sylvicultural research in India and Burma were a "Sylvicultural Research Manual for India", in two volumes—"The Experimental Manual" and "The Statistical Code"—and a "Preliminary Survey of the Forest Types in India and Burma".

The opening paragraph of the "Research Manual" is testimony to Mr. Champion's methods—"Research work ought never to be hampered by compulsory adherence to any prescribed methods of investigation or of recording. This does not, however, prevent the research worker from receiving considerable aid from the results of his own experience and that of others". This dictum he illustrated in his "Problem of the Pure Teak Plantation", which included valuable notes supplied by the Forest Research Institute of the Dutch East Indies. Other monographs published were notes on *Pinus longifolia*; contributions towards a knowledge of twisted fibre in trees; the importance of the origin of seed used in forestry; rejuvenation and management of sal (*Shorea robusta*); and a "Manual of Indian Sylviculture" (with Sir Gerald Trevor). In addition to visiting all parts of India and Burma as sylviculturist, Mr. Champion was asked by the Government to advise on the management of the Ceylon forests. He visited North America, Japan and Malaya to study local forest soil conservation problems, and saw something of the Kenya forests on his way home on leave in 1939.

Prof. W. P. Jorissen

The Netherlands Chemical Society announced on December 23 that Prof. W. P. Jorissen is retiring from the editorship of the *Chemisch Weekblad* after serving that journal for thirty years. Although Holland is a small country, it has for many centuries been to the fore in the advancement of science, and Prof. Jorissen, who celebrated his seventieth birthday on November 11, 1939, will rank as one of the country's most distinguished chemists. Since his first paper in 1894 dealing with the oxidation of phosphorus, he and his collaborators have contributed many papers from the laboratory for physical chemistry at the University of Leyden. The most important of these deal with his detailed study of the regions of reactions among gases, and even among solids, and with the physical chemistry of explosions (notably the limits). In addition to his academic and research activities at Leyden, Prof. Jorissen, who is an excellent linguist, was editor-in-chief of the *Recueil des travaux chimiques des Pays-Bas* as well as of the *Chemisch Weekblad*. This brought him into lasting contact with the many British chemists who have had occasion to contribute to this Netherlands monthly journal, which publishes communications in French, German and English. We join with his Netherlands colleagues in wishing Prof. Jorissen a long and happy retirement.

Parliamentary and Scientific Committee: New Chairman

At the last general meeting of the Parliamentary and Scientific Committee at the House of Commons, Captain L. F. Plugge, M.P., was unanimously elected chairman. Captain Plugge is a science graduate of the University of London and also of the University of Brussels. During the War of 1914–18, when serving with the Royal Naval Air Service, he was the Admiralty representative at the National Physical Laboratory at Teddington. He also served on the directorate of Aeronautical Research at the Air Ministry under Sir Robert Brooke-Popham, when he evolved in collaboration with Dr. Thurston the design of the first military aeroplane constructed entirely in metal to be built in Great Britain. He has been a fellow of the Royal Aeronautical Society since 1923, and was responsible for the Society's glossary of aeronautical terms (French translation). His work on wireless, which has covered the last fifteen years, is well known, and he is an authority on matters relating to broadcasting.

The University of Cracow

Expressions of sympathy have been received by the Polish Ambassador in Great Britain from universities in Great Britain, the Association of University Teachers and the Universities Bureau of the British Empire in reply to a statement concerning German activities in connexion with the University of Cracow (*The Times*, Dec. 22). It appears that the members of the teaching staff of the University were invited to attend a conference at which the German attitude toward Polish men of learning was to be explained. The tone of the address offended the audience, who walked out, to find lorries waiting outside, in which they were removed and sent eventually to a concentration camp in Germany.

It is stated that 160 members of the University are involved, including Prof. Kazimierz Kostanecki, a former president of the Polish Academy of Sciences, and Adam Krzyzanowski, a distinguished economist, who has since died. A message from the University of Leeds contains the following passage: "The members of the Senate of the University of Leeds . . . desire to place on record their strong condemnation of an action which can have no military justification and must be regarded as part of a deliberate and wanton attempt to destroy the culture and learning of the Polish peoples." We are sure that readers of Nature will be in hearty support of this view.

The University of Birmingham

The University of Birmingham has settled down to war conditions more smoothly than was anticipated, thanks largely to the recruiting policy of the Government whereby some of the deplorable errors of the War of 1914–18 in the waste of ability of university students have been avoided. The number of students in some departments has actually increased, and in the department of medicine in particular the number of full-time freshmen has reached a total of forty-four more than that of last year. The Nuffield Physics Extension Block is nearly ready for occupation, but the exigencies of war-time have unfortunately interrupted the building of Prof. Oliphant's large cyclotron, which is to be the chief feature of the new block.

The new gymnasium of the University also is nearly complete, and it is hoped that it will be used in the near future for physical training. The plans for extension of the Students' Union have had to be dropped for the present. Extra-mural work under the Joint Committee of the University and the Workers' Educational Association has made progress and the number of classes and students has increased. Prof. W. K. Hancock has been given leave of absence to visit West Africa for a study of West African problems in continuance of his "Survey of British Commonwealth Affairs". Dr. O. Frisch of Copenhagen has been appointed a temporary member of the staff of the Physics Department.

Social Services for Youth

THE Board of Education has directed attention to a serious deficiency in our social services in a circular recently issued to the local education authorities for higher education in England and Wales, and a similar circular has been issued by the Secretary of State for Scotland to the education authorities in Scotland. These authorities are asked to take steps to set up local youth committees in their areas, and voluntary organizations and education authorities are called upon to combine in making real provision for the social and physical development of young persons between the ages of fourteen and twenty who have ceased full-time attendance at school. This neglected and elusive problem has been accentuated by war conditions—the black-out, the strain and disorganization of family life—and the Board of Education has now assumed a direct responsibility for juvenile welfare. The National Youth Committee has been appointed to advise them and a special branch of the Board of Education office has been organized to deal with grants and other administrative duties.

The new committees will place youth work on an equal basis with the rest of education. Sometimes they will be sub-committees of local authorities; others may represent all local interests including the local authority. Their task will be to work out an ordered policy, meeting both the immediate needs and indicating the lines of advance under more favourable conditions. Local education authorities are expected to see that the Committee is properly staffed and equipped with office accommodation, and they can assist financially by making grants towards the rent of buildings, salaries of full-time leaders, upkeep and maintenance of premises, including provision of equipment and instructors. The appointment of the National Youth Committee has been welcomed by the King in a message to the Prime Minister, in which His Majesty appeals to the public for volunteers to undertake the tasks of leadership and organization which these plans envisage, and an announcement asking for volunteers has already been made by the President of the Board of Education and the Secretary of State for Scotland at the request of the National Youth Committee.

American Psychologists in War-time

AMERICA believes in being forearmed. Already the American Association for Applied Psychology has devised a plan to mobilize psychologists to aid the Government in time of emergency as they did in 1918 (Science Service, Washington, D.C.). The chief problems to be considered are connected with the selecting and classifying of men according to their abilities, the selecting of promising recruits for military flying, treating those who break down under the strain of war and discipline, and keeping up the morale of armed forces and those at home. The human element and human 'nerves' are much more important now than in the War of 1914–18, although even then a considerable proportion of war casualties were 'nervous' cases.

At the meeting which discussed the matter there were representatives of the Army and Navy, the Public Health Service, and the Department of Justice. The armed services have already arranged to avoid in any future war the heavy psychological casualties of the last war. The first step has been to provide for the careful psychiatric examination of all new recruits, with an observation period in which any border-line cases might be weeded out or assigned to jobs where personality difficulties will be at a minimum. They are also discussing whether, by means parallel to those used by enemy agents to foment discord, psychologists could be used to promote good feeling and smooth out grievances.

Aquaria Societies' Difficulties

THE wartime difficulties of aquaria societies, especially those which maintain public aquaria, have not proved so disastrous as at first expected. The Scottish Aquarium Society, at a recent meeting, decided to produce a modified edition of its journal *Scottish Aquarium Herald*, as Mr. R. Kerr, the original editor, is serving in H.M. Navy. Brighton Aquarium recently acquired an attractive exhibit of 120 silver whiting (*Gadus merl angus*), as well as congers, anglers, spider crabs, ocean sunfish and an owl fish. The Carnegie Aquarium at Edinburgh is also managing to keep a full stock of exhibits, including herring. Manchester Zoo Aquarium has 41 specimens of *Neon tetra* on view in the tropical section, as well as a large electric eel. Dudley (Worcestershire) Zoo Aquarium recently received some claw-footed toads.

On the Continent, Paris Zoo Aquarium has distributed its fish to the Prince of Monaco's Aquarium at Monte Carlo and to private individuals, and its reptiles to Marseilles Zoo. The aquarium at Berlin Zoo has been broken up and closed and the reptiles destroyed. Hamburg Zoo has disposed of all its collection. Belle Vue (Manchester) Aquarium and Vivarium Society has decided to levy half the normal subscription and review the position again in six months' time.

Archæological Discoveries of 1939 in Ireland

ARCHÆOLOGICAL excavations in the vicinity of Lough Gur, Co. Limerick, in the season 1939, it is claimed in a report in *The Times* of January 2, have obtained results of outstanding significance for Irish archæology. This area has now been under investigation for four consecutive seasons, thanks to the Government's scheme for the relief of unemployment;

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and several sites have been examined, including three stone circles, a megalithic tomb, and a series of dwelling sites. The excavations have been carried out under the direction of Prof. Seán P. O'Riordain of the University of Cork. The principal site excavated in 1939 was a large and exceedingly well-preserved stone circle on the western side of the lake, near the Bruff-Limerick road. Not only is this the best known prehistoric monument of the Lough Gur, but it is also said to be the finest stone circle in Ireland. It is built of large stones backed up by a huge bank of earth, and encloses a level, open internal space 155 ft. in diameter.

Here important finds of pottery were made, of which some afford evidence for a new chapter in Irish archæology. A reconstructed vessel proved to be a 'beaker', the first of its kind to be found in Ireland. It belongs to the class of ceramic characteristic of the 'Beaker Folk', who reached Britain in the late neolithic or Early Bronze ages, but, it has been thought hitherto, did not reach Ireland. A further discovery of considerable interest is that of neolithic pottery of types found only sporadically in Ireland, except in the north-east. On the evidence of the finds, the circle is dated at approximately 1700 B.C., and its ritual purpose, that of a prehistoric temple, is regarded as definitely determined. In a group of neolithic houses on the peninsula of Knockadoon in Lough Gur, one, exceptionally well-constructed, is said to be the earliest house yet found in Ireland. It is 32 ft. long by 18 ft. wide. The lower part of the walls is of stone, the superstructure of wood and thatch—a type well known from various periods in northern Europe.

Landscape Meteorology

MR. L. C. W. BONACINA's paper entitled "Landscape Meteorology and its Reflection in Art and Literature" (*Quart. J. Roy. Meteor. Soc.*, 65, No. 282; October 1939) is a detailed study of the scenic aspect of. clouds and weather, and an example of that co-operation between science and art which is one of the most interesting developments of culture during recent years. We welcome particularly the author's dictum that it is a mistake for the man of science to regard scenic values as altogether outside his province. It is equally to the point that the landscape artist will find additional enjoyment, and possibly also increased efficiency, if he studies the physics of meteorological effects. The later part of the paper is mainly devoted to descriptions of local and seasonal phenomena. One outstanding example is that of the night sky as seen from the high plateau of Bolivia, where the general aspect of the constellations is that of coloured stars.

Valuable as is this elaborate paper, the reader cannot help feeling how great is the difficulty of bringing the artistic and scientific aspects of a subject into one essay. The perceptive and reflective moods are alternate, and the literary technique for their simultaneous treatment has not been fully mastered. Indeed, we do not yet know if it can be mastered. If so, it will be by Ruskin re-incarnate in the world of to-day, with the same faculties of sight and expression but imbued with the culture of the present time.

Malnutrition in South Africa

AN informative survey of the state of nutrition of the peoples of South Africa is given by Ellen Radloff and T. W. B. Osborn in a pamphlet with the above title (Johannesburg: The Witwatersrand University Press, 1939. 2*s*.). South Africa has been spoken of as the most prosperous country in the world, which is a true statement for a minority of the European section. But South Africa is also a country of poor whites and poorer blacks, which is true for several millions of non-Europeans and several hundred thousands of Europeans. The principal dietary essentials for proper nutrition are discussed, with descriptions of the conditions that result when these are deficient. Tables are given of the vitamin content of common foodstuffs and of typical South African diets.

The basic ration scale recommended for adult Europeans at the Health Department's institutions appears to be ample and adequate, and is in striking contrast to the daily diet scale for adult native paupers in Cape Province, which consists of 1 oz. of fat (not butter) and 24 oz. of mealies. Remedies are suggested for the malnutrition that exists, which include improvement of the economic condition of the people, educating them to buy meat, milk, fruit and vegetables, and in rural communities providing more land for them to buy and improving their grade of cattle. A direct pharmacological approach to the question is also suggested by providing rations of essential salts and vitamins.

Underground—and the City of the Future

IN the *Beama* journal of November reference is made to Le Corbusier's city of the future consisting of dwellings, offices, and factories contained in huge blocks separated by gardens. One of the main features of this modern city is the large part of its activity which takes place underground. Power stations, garages, warehouses and other public service buildings, as well as traffic routes for vehicles and pedestrians, would be constructed in this way. Already there exists a plan for the diversion of a large part of the Paris traffic, the underground routes for which were examined by the Minister of Public Works some years ago. *Électricité* published a report on this subject by M. Roger d'Arboville, professor of applied electricity in the well-known École spéciale d'Architecture, on the lighting of underground traffic and pedestrian routes. He reviews the practice exemplified in some of the short subways in Paris, in the long road tunnel projected for 1941 under the Meuse, the mile-long roadway under the Escaut at Antwerp and various railway tunnels in France and England.

M. d'Arboville discusses the question of the lighting of underground road tunnels both in actual road tunnels and in many tunnels which are projected. The ever-increasing density and speed of road traffic make this question of great importance, especially at the entrances to the tunnels. The light conditions at these places must be very carefully graded or else the speed of all transport entering the tunnel must be heavily stepped down. The latter course is objectionable as it interferes with the normal flow over a wide area. He suggests that photo-electric cells might be used to maintain the lighting more constant and so overcome the changing variations of natural light. The photo-cells should be directed towards the ground, since otherwise the effect of sunlight variations is too strong.

Dismantling an Old Colliery

WE learn from an article in *Roads and Road Construction* of December 1 that the famous Cymmer Colliery at Porth, Glam., from which coal has been raised for more than a hundred years, has recently ceased work. The immense quantity of plant which it contains is to be dismantled and made available for use either in the coal industry or in similar industries engaged on contracts of national importance. In the history of this colliery, which once employed more than three thousand men and produced more than three thousand tons of coal a day, an interesting story is told of how about fifty years ago, whilst boring in the shaft for piping supports, the men struck what is called a 'gas blower', which is a sort of pocket of free gas. In these days men were permitted to take naked lights down in the cage with them so that they could heat their tea, and one of these lights ignited the natural gas. As it was dangerous to allow such gas to escape into the shaft, a two-inch pipe was installed to conduct it to the surface. Here it has been burning for fifty years without being extinguished. Measurements show that approximately 650 cub. ft. per hour was being emitted at the 'blow'. The gas is chiefly methane, and arrangements have now been made to 'bottle' it in steel cylinders at about 800 lb. per sq. in. pressure for scientific and industrial use.

Messrs. George Cohen of London and Swansea are at the present time running a 5,000 cub. ft. vertical engine-driven compressor now in the mine to supply air to the haulages for removing the underground plant and machinery, of which there is no less than 4,000 tons, including about 1,200 tons of pit rails. Compressed air was also supplied below for working coal-cutters, jigger conveyors, belt conveyors, and turbine fans. Electric light, both for underground and surface, is supplied by steam-driven generating sets. In 1933 a modern dry coal cleaning plant of 75 tons per hour capacity was installed at a cost of about £20,000 by the Birtley Iron Co. The roads to the pit are in excellent condition, being supported by about 1,700 tons of steel arches, of which Messrs. Cohen expect to recover about 500 tons.

Hydro-Electric Development in India

RECENT reports from India, referred to in *Beama* of November, state that a very large irrigation scheme which will include the generation of large quantities of electric power between the Punjab and the State of Bilaspur is under construction. The volume of water that will be impounded is three times as large as that of the Aswan dam across the Nile. A further scheme for the development of water power utilizes the high run-off of the monsoon rains from the High Range Hills to the plain at Travancore in southern India. Power is obtained from the Munnar River as it descends in a series of cascades from the hills. The monsoon waters are impounded in storage reservoirs built on natural sites. The power station is built on the banks of the river, with the tail-race planned to discharge into it. Above stream, the river water is decanted by a weir, then passes through a channel to the tunnel and forebay. From there it is carried in a 10,000 ft. long tunnel an open channel was impracticable owing to the crumbling nature of the surface rock—to the surge tower. Two parallel pipe-lines connect with the power house, each supplying water to a 6,000 brake horse-power turbine.

Weather by Telephone in New York

ACCORDING to the *Bell Laboratories Record* of November, the New York Telephone Co. inaugurated a new service last April. It is now possible in the Metropolitan area to dial 'weather', and hear the latest weather prediction, including the anticipated temperature, winds, and rain or snow conditions. The bulletins are based on direct teletype reports from the United States Weather Bureau ; at present these reports are changed hourly between seven in the morning and eleven at night. When important changes occur, special bulletins may also be given. All the equipment used for this service is installed in the West Fiftieth Street Central Office building, and weather announcing trunk lines are run to all the central offices in Manhattan, while other parts of the metropolitan area reach the announcing bureau through subcentres or tandem offices. In the time-announcing system a special operator makes each announcement herself. In the weather system use is made of a recorder using magnetic tape. It is well suited for this service as it is necessary to change the recorded message frequently and permanent preservation of the record is of no importance.

The record is made in the usual way by producing, in a moving steel tape, a magnetic pattern corresponding to the voice current coming from the microphone circuit. This pattern remains in the tape and can be 'picked up' electrically many thousands of times before being erased. This is done by saturating the tape with a strong magnetic field. The entire process of erasing, recording a new message and reproducing is controlled by a few keys in the operating turret. No experience or technique is required to obtain exact reproduction of the announcement, and since the steel tape can be used again and again indefinitely, there is no continuing expense for record material and no processing cost involved. Three of these machines are used. The tape machine employs slightly more than 40 ft. of tape wound on three brass drums. The two ends of the tape are electrically welded so that it forms a single tape loop.

Demography of Canada

According to the report recently made to the International Office of Public Health (*Bull. Off. internat. d'hyg. publ.*, 31, 1678; 1939) by Dr. H. B. Jeffs, the delegate for Canada, the population of Canada, exclusive of Yukon and the North Western Territories, amounted to about 11,106,000 on June 1, 1937. The marriage-rate for 1937 was 7·9 per 1,000 inhabitants. The highest percentage of marriages was registered in Manitoba (8·5) and the lowest in Saskatchewan (6·2). The birth-rate was 19·8 per 1,000 inhabitants as compared with 20·0 in 1936. The total number of live births was 219,988 in 1937, as compared with 220,371 in the previous year. The highest birth-rate was in the province of Quebec, where 75,635 births were registered or a rate of 24·1 per thousand inhabitants. In 1937, 113,694 deaths were registered in Canada or a mortality of 10·2 per 1,000 inhabitants, as compared with 9·7 in 1936. The total number of deaths of children under one year of age was 16,675 or a mortality of 76 per 1,000 live births as compared with 66 in 1936. The maternal mortality was 1,067 in 1937 or a mortality of 4·9 per 1,000 live births, as compared with 1,233 deaths or a rate of 5·6 in 1936. The highest maternal mortality was in Prince Edward Island (5·8 per 1,000 live births) and the lowest in Nova Scotia (2·7 per 1,000 live births).

A New Biological Journal

Under the title of *Lloydia* the Lloyd Library of Natural History, Cincinnati, Ohio, has commenced the publication of a new quarterly journal of which the first number appeared as Vol. 1, Nos. 1–4, 1938; the date of publication is given as January 7, 1939, but a copy has only just reached Nature. The subscription rate is three dollars per annum. The editor is Theodor Just. From the numbers already published, the main field of the new journal would seem to be systematic, but papers dealing mainly with structure have been published and many of the communications have been freely illustrated with both drawings and photographs. Manuscript contributions are welcomed, as also exchanges with other institutions. Communications should be addressed to the Librarian, Lloyd Library, 309 W. Court Street, Cincinnati, Ohio.

Bibliography of Seismology

The *Bibliography of Seismology*, 13, No. 2, published by the Dominion Observatory at Ottawa, has just been received. It contains 124 items over the period April, May, June 1939, and has been compiled with the assistance of collaborators in Canada, United States, New Zealand, Italy, Germany, Norway, Japan, U.S.S.R., France, Holland and England. As in the preceding number, in addition to works on pure seismology, there is again a considerable number of works listed on applied seismology, chiefly concerned with geophysical prospecting. A list of patents concerned with this latter contains eight items, five being United States patents, one Canadian, and two U.S.S.R. It is pleasing to see a considerable number of papers listed from the Seismological Institute, Academy of Sciences, U.S.S.R., though it would add to the value of these Russian works if the authors supplied translations or abstracts in French, German or English. Unfortunately, again South America is not represented.

Earthquake in Central America

An earthquake of considerable intensity was experienced on the Pacific coast of central America on December 5 just after 8.30 G.M.T., though no damage has been reported. The shock was recorded on practically all the seismographs in America; at De Bilt (Holland), where the preliminary waves arrived just after 8.42; and at Kew, where a full complement of waves including P_cP, *SKS* and *SSS* were readily discernible. The maximum ground displacement at Kew was 0·043 mm. From readings of seismograms at adjacent stations, the epicentre has been determined by the United States Coast and Geodetic Survey to have been in the Pacific Ocean some twenty miles due east of Rio Suchiate (Guatemala).

Announcements

The U.S.S.R. Academy of Sciences has marked the sixtieth birthday of M. Joseph Stalin by electing him an honorary member of the Academy, nominally in recognition of his contributions to the development of the social theories of Marx and Lenin. It should be noted that even the ordinary membership of the Academy is restricted to a limited number of men of science of outstanding repute, while there are very few honorary members, all of them hitherto being scientific men of international fame.

Prof. Fritz Lejeune, of Cologne, has been appointed professor of the history of medicine and director of the Institute of the History of Medicine at Vienna.

The Italian Minister of the Interior has offered a prize of 30,000 lire for the discovery of chemical or biological substances to take the place of insulin.

The League of Nations Health Committee has arranged to set up a sub-committee which may be summoned in an emergency to deal with epidemics of infectious diseases arising out of the War.

The Ministry of Health has published a memorandum on typhoid fever for the use of local authorities and medical officers of health (Memo. 225/Med. H.M. Stationery Office. 2*d.* net). The memorandum deals with typhoid and paratyphoid fevers, their history, diagnosis, prevention and control, and it contains an appendix on laboratory methods of diagnosis.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 32. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Factor influencing Nitrogen Excretion from Leguminous Root Nodules

THE excretion of nitrogen compounds from leguminous root nodules which has been demonstrated in this laboratory with a sterile culture system and, from the practical point of view, investigated with ordinary pot cultures, has not been shown in the pot cultures of all investigators[1,2]. With a sterile culture system Wilson has accomplished the excretion almost regularly[3].

It is difficult for us to explain the negative results appearing in the literature since, during 1928–38, we have regularly obtained excretion, and often a very powerful one, in hundreds of experiments also with pot cultures. In 1938 and 1939, however, excretion occurred only in a part of the experiments. Of parallel cultures under the same conditions, some showed powerful excretion while little or no excretion occurred in others. Light intensity could therefore not be the cause of conflicting results, as the plants were growing under identical conditions. There was also no difference in the quality of the quartz sand used in them.

In trying to discover the cause of these variations we finally paid attention to the quality of the containers. We have always used unglazed pots of burned clay. When we examined the pots used in the summers of 1938 and 1939 we noted great variations in their porosity. The pots in which oats grew fairly well in association with inoculated peas proved to be more porous than those where the growth of the oats was poor. The porosity of the pots was measured by allowing them to soak in water and determining the time which was required to make the inside of the pot moist. The accompanying table illustrates some of our results.

* Unglazed burned clay pots, diam. 9 in., 7·75 kgm. quartz sand, 4 peas (inoculated with bacterial strain *H X*) and 6 oats (Guldregn II) in each pot. Control: 6 oats alone. N-free nutrient solution. Period of growth: 20 July–25 Sept. 1939. 3 parallel experiments.

Variety of pea	N in peas, mgm.	N in oats, mgm.	Excreted N taken up by oat, mgm.	Soaking time of the pot, min.
Adoptive	172·2	69·6	55·2	33
	100·8	40·9	26·1	31
	187·6	24·1	9·3	105
Concordia	204·3	48·2	33·4	20
	439·9	13·4	− 1·4	80
	247·6	32·5	17·7	25
Marmor. Glænö	167·8	74·2	59·4	45
	546·1	17·9	3·1	165
	616·9	13·4	− 1·4	160
Control		15·4		
		14·8 } 14·8		
		14·3		

Our results show that the growth of oats in associated culture with pea depends evidently on the porosity of the culture pot, and thus on the aeration of the media. As the experimental conditions—sand and nutrient solution—have been identical in all experiments, only the difference in the quality of the pots can explain the decided variations in the excretion of the parallel cultures. The experimental data also illustrate the fact noted earlier that when the excretion is high the growth of the pea is often, though not always, impaired.

When the excretion of nitrogen from the leguminous root nodules is investigated in associated cultures with ordinary pot cultures, containers should be clay pots, which are very porous. Large pots generally give better results than small ones.

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Nov. 30.

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[1] Bond, NATURE, **140**, 683 (1937).

[2] Wilson, NATURE, **140**, 154 (1937).

[3] Wilson, *J. Agric. Sci.*, **27**, 307 (1938).

Effects of Concentrated Aqueous and certain Non-aqueous Solutions of Alkali upon Wool

CHEMISTS are well aware that wool is readily attacked by alkaline reagents. These disrupt the disulphide groups of the cystine contained in the polypeptide chains, thus weakening the fibre structure. The woollen manufacturer also recognizes that wool is susceptible to attack by alkali, as the term 'alkali damage' indicates. This damage frequently results from inefficient scouring which afterwards causes the wool to dye unevenly.

The surprising fact that the fibre is not seriously damaged by cold, concentrated, aqueous solutions of sodium hydroxide was investigated by Buntrock[1], Matthews[2], and Speakman[3]. The two earlier workers showed that yarns, treated with 52 per cent aqueous sodium hydroxide solutions, became stronger. Matthews reported that the sulphur content was greatly lowered by the treatment, that the surface scales of the individual fibres fused together, that the ability of the wool to felt was not reduced, and that its affinity for acid dyes was increased. Speakman showed that the strength of individual fibres was unaffected by this treatment. He suggested that the increased strength of yarns was due to the fusing together of different fibres under the influence of weakly alkaline solutions formed during the processes involved in the removal of the alkali from the wool. Some of these matters have been reinvestigated by us, and particular attention has been given to the removal of the alkali in such a way that risk of damage to the fibres in this process was minimized. A summary of our results follows.

(1) The sulphur and nitrogen contents of merino wools are very little altered by immersion in 52 per cent sodium hydroxide for periods up to 30 minutes at room temperatures.

(2) No major changes in the surface structure of the fibre result from such a treatment for 5–10 minutes. Microscopic examination shows little or no difference between treated and untreated fibres.

(3) Wool treated with concentrated solutions of sodium hydroxide absorbs acid dyes *evenly*. Such wools have a greater affinity for acid dyes than similar untreated wools.

(4) A woven woollen fabric treated with 52 per cent sodium hydroxide shows less tendency to shrink on washing than a normal fabric.

These studies have been extended to the treatment of wool with alkalis dissolved in certain organic solvents. By using much weaker alcoholic solutions of sodium (or potassium) hydroxide, similar results to those obtained with concentrated aqueous solutions can be obtained with less risk of damage to the wool. The reduced tendency of treated wools to shrink, moreover, is much more marked, especially when knitted fabrics are used. This has been found to depend on:

(*a*) The nature of the alkali used. Potassium hydroxide gives slightly better and more even results than sodium hydroxide.

(*b*) The nature of the solvent. Solutions of alkali in dry methyl alcohol give less satisfactory results than similar solutions in alcohols of higher molecular weight.

(*c*) The percentage of water present in the solvent. The results are obtained slowly with dry reagents and quickly if 10 per cent or more of water is present. Damage to the fibre is more likely at these higher concentrations, and the optimum water content for speed of reaction, ease of control and minimum risk of damage is about 5 per cent.

The time of reaction depends on the concentration of the alkali used; thus we have found that with more dilute solutions longer immersion periods are required to give satisfactory results.

The limits that have been found with 7 per cent potassium hydroxide solutions are 1–30 minutes, depending on the water content of the alcohol used, and the treatment period may be extended to 16 hours with similar solutions of 0·05 per cent concentration. The rate of action increases with temperature.

Risk of damage to fibres after they have been treated with alcoholic solutions of alkali is eliminated by neutralizing excess alkali in a bath of 5 per cent, by volume, concentrated commercial sulphuric acid in alcohol. If hydrogen sulphide is evolved during the treatment it indicates that the process has been carried out incorrectly, and the wool will probably be damaged.

As regards strength and ability to stretch, treated fibres are not different from untreated. Their surface, however, is rougher than that of untreated fibres. These physical tests have been made by our colleague, Mr. E. H. Mercer, who has also noted that the more tightly twisted yarns of treated fibres are stronger than similar yarns of normal wool.

This method of treating wool promises to be of importance from both the commercial and the purely scientific points of view. Commercially, a treatment of wool for less than two minutes may give a product which is substantially non-felting, which absorbs dyes more readily, which can be made into stronger yarns, which will wear more satisfactorily than normal wool, and which shows less tendency to develop a fluffy surface during wear. Scientifically, the reagents may prove useful in further study of (*a*) the capacity of wool to combine with alkali; (*b*) the cause of felting and shrinkage resulting from this; and (*c*) the molecular structure of wool.

A full account of our work will be published shortly as a bulletin of the Council for Scientific and Industrial Research. The work has been facilitated by financial assistance granted by the Australian Wool Board.

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[1] Buntrock, *Farber Z.*, **9**, 169 (1898).

[2] Matthews, *J. Soc. Chem. Ind.*, **21**, 185 (1902).

[3] Speakman, *J. Soc. Chem. Ind.*, **118**, 321 (1929).

Amine Oxidase and Benzedrine

EXPERIMENTS which we have carried out during recent years seem to be of general interest in connexion with the observation reported by Mann and Quastel[1] on the effect of benzedrine (β-phenyl*iso*propylamine) on the metabolism of the central nervous system. First, it now seems possible to relate the action of the drug to an *in vitro* effect on one of the enzymic systems in the body; secondly, we can in this instance relate the action of the drug to its chemical structure. The effect on metabolism finds its explanation in the inhibitor action of β-phenyl*iso*propylamine and its derivatives on amine oxidase. This effect was first described for ephedrine[2], but it was shown soon afterwards that ephedrine shared it with all other derivatives of β-phenyl*iso*propylamine that were examined[3]. The general rule emerged from these experiments that substances of the constitution $R—\overset{|}{\underset{|}{C}}—CH.NH_2—CH_3$ act as inhibitors of the enzyme. The characteristic difference between substrates and inhibitors of amine oxidase is that the latter contain the amino group not attached to a terminal carbon atom of a chain. It is known that the awakening effect of these drugs is also bound up with this characteristic structure, and that it is absent from those substances in which the amino group is attached to a terminal C atom of a chain[4,5]

Partly through the kindness of Dr. G. A. Alles, of Los Angeles, I have recently had the opportunity of examining a number of different amines of this group and have shown that a further subdivision of the β-phenyl*iso*propylamine group of inhibitors is possible. Substances of the structure $R—CH_2—CH.NH_2—CH_3$, for example, veritol and benzedrine, are much stronger inhibitors of amine oxidase than those of the structure $R—CHOH—CH.NH_2—CH_3$, for example, ephedrine; a comparison with the awakening properties of these substances in the living animal shows that there is again agreement between *in vitro* effect and pharmacological action[4]*.

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Dec. 8.

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* These experiments were carried out with a grant from the Ella Sachs Plotz Foundation.

[1] Mann and Quastel, NATURE, **144**, 943 (1939).

[2] Blaschko, Richter and Schlossmann, *Biochem. J.*, **31**, 2187 (1937).

[3] Blaschko, *J. Physiol.*, **93**, 7P (1938).

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[5] Alles, *Amer. J. Physiol.*, **126**, 420 (1939).

Electrophoresis of Animal Viruses and their Neutralizing Antibodies in Low Concentrations

A PERUSAL of the literature dealing with the physico-chemical properties of animal viruses and their neutralizing antibodies reveals the fact that very little attention has been given to the mobility in an electric field of these important substances.

The main investigations on the electrophoresis of viruses and their neutralizing antibodies have been to determine the sign of the charge and the direction of mobility[1,2,3], the separation of virus from virus-antibody mixtures[4,5], and the recovery of virus from the brains and spleens of animals recovered from virus diseases[5].

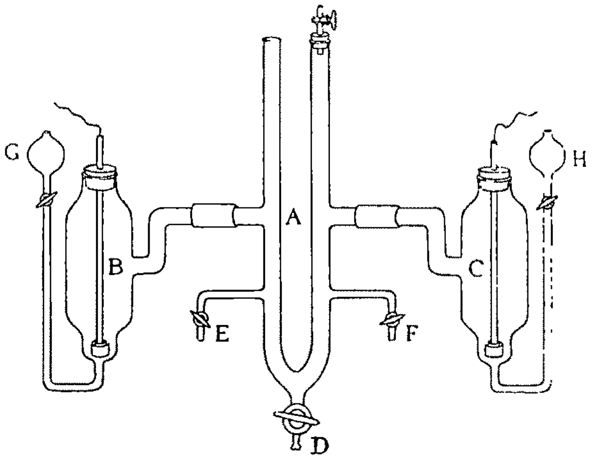
In none of the above-mentioned investigations has any attempt been made to determine the rate of migration of the viruses or their neutralizing antibodies, as the apparatus employed was highly unsuitable for that purpose. In order to measure the migration of viruses and their neutralizing antibodies an apparatus was constructed which has been applied with success to such measurements.

With the aid of the accompanying diagram the essential parts of the apparatus can be explained. *B* and *C* are two electrode vessels connected up to the U-tube *A* in the way illustrated. Two reversible silver–silver-chloride electrodes in saturated potassium chloride solution serve as anode and cathode. The electrode vessels and U-tube are filled with buffer against which the substance has previously been dialysed. By means of the two vessels *G* and *H* saturated potassium chloride solution is let into the electrode vessels to cover the electrodes. The virus or antibody in serum buffer mixture is let through the tap *D* to form a boundary under the buffer solution in *A*. The boundaries are brought up to levels above the two taps *E* and *F*. A position is marked off 2 cm. above the boundaries between the buffer and serum buffer mixture, and the electric current switched on. At the position 2 cm. from the original boundary small samples of fluid (0·1 c.c.) are carefully pipetted off with a fine pipette after suitable time intervals and tested by means of biological methods for virus or antibodies. The limb of the U-tube in which the samples are not taken is kept closed by means of a stopcock. The samples remain negative until the virus or antibodies reach the pipette.

The mobility of the substance investigated is given by the equation[6]

$$\mu = D\,x\,O/tA,$$

where D is the distance traversed by the substance (here 2 cm.); x is the conductivity of the solution; O is the cross-section of the U-tube at the point where the samples are taken; t is the time required for the substance to traverse the distance D; A is the strength of the electric current.



By plotting the mobilities at various hydrogen ion concentrations against the hydrogen ion concentrations of the buffer, the iso-electric point can be determined by extrapolation or interpolation[6]. The experiments are conducted in a room at constant temperature and a small current is employed, generally 1 milliampere, to minimize heating effects which might cause convection currents. It would be more preferable to conduct the experiments in a water thermostat. The apparatus employed is a modification of the Tiselius moving boundary method[6,7], but it is less complicated and less expensive, and with suitable optical arrangements and proper thermostatic control it can be used for similar purposes, for example, separation of the components in protein mixtures.

An extensive report on the electrophoresis of viruses and their neutralizing antibodies will be published in the *Onderstepoort Journal*.

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[1] Todd, *Brit. J. Exp. Path.*, 8, 369 (1927).

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[3] Douglas, Wilson-Smith, *Brit. J. Exp. Path.*, **9**, 213 (1928).

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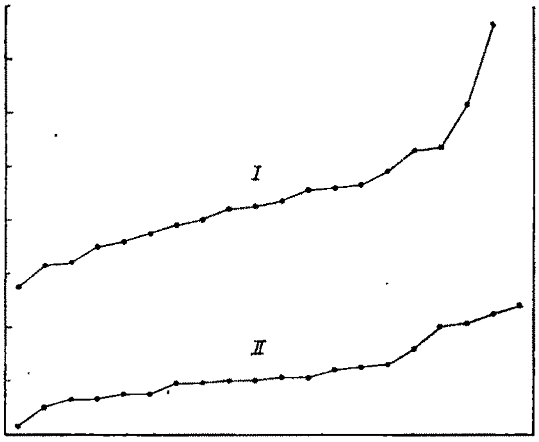
[5] Olitski, Long, *J. Exp. Med.*, **50**, 263 (1929).

[6] Tiselius, Dissertation, Uppsala (1930).

[7] Tiselius, *Trans. Farad. Soc.*, **33**, 524 (1937).

Relation between Corpus allatum and Ovaries in Adult Flies (Muscidæ)

THE adult Muscids examined by me (Musca, Calliphora and Lucilia) possess an unpaired median corpus allatum which is situated dorsal to the œsophagus in the region connecting the neck with the prothorax. Just beneath the corpus allatum lies the aorta, beneath this comes a sympathetic ganglion (ganglion hypocerebrale), and below this lies the œsophagus. An examination of newly hatched unfed females of *Musca domestica* showed the presence of a small rather flat corpus allatum, whereas the same organ of mature females was considerably larger, which was also the case in Calliphora and Lucilia. Thus it seems reasonable to assume that the corpus allatum of adult Muscidæ has a function similar to that of the corpus allatum of the adult female Rhodnius as found by Wigglesworth[1] (cf. also experiments of Weed on Melanoplus[2]), that is, to control the development of the ovaries. In order to test this hypothesis I removed the corpus allatum of rather newly hatched unfed females of Calliphora and Lucilia. It proved possible to extirpate the corpus allatum solely without damaging the aorta. The mortality was low; out of seventeen Calliphora which had their corpus allatum extirpated three died. After six days at 25° C. and normal feeding (sugar, meat and water) thirteen of the fourteen survivors showed small slightly developed ovaries, whereas one had large ovaries with nearly mature eggs. Thirteen of the fifteen operated controls (none of which died) had large nearly mature ovaries, and two had somewhat smaller ovaries with conspicuous nurse cells; but these ovaries were much larger and much more developed than the ovaries of the thirteen individuals from which the corpus allatum had been excised.



RELATIVE AREAS OF CORPORA ALLATA IN CASTRATED CALLIPHORA FEMALES (I) AND OPERATED CONTROLS (II).

Fourteen about one-day-old unfed Lucilia females had their corpus allatum extirpated. After six days at 25° C. and normal feeding, nine showed small slightly developed ovaries; in one fly the ovaries were somewhat larger, two had ovaries with conspicuous nurse cells, and two had large nearly mature ovaries. Out of ten operated controls, one died, the surviving nine all showed large mature ovaries. The small ovaries of the flies without corpus allatum seem to have stopped growth at the same stage of development.

It would appear from these experiments that the corpus allatum of Calliphora and Lucilia females produces a hormone which regulates maturation of the ovaries, just as is the case in Rhodnius.

The growth of the ovaries in some individuals, in spite of the removal of the corpus allatum, may be explained in one of two ways:

(1) Already before the extirpation the corpus allatum has produced sufficient hormone to induce maturation of the eggs.

(2) A small piece of the corpus allatum may have remained in the animal and produced the hormone necessary for maturation of the eggs.

If the first hypothesis is the right one, it should be possible to determine a critical period for the effect of the hormone by using flies the age of which is exactly known. Experiments have been begun to test this.

In dissecting females of Lucilia, four flies were found to possess an abnormally large corpus allatum and very small undeveloped ovaries. According to the known age of two of these flies, they ought to have been mature. Two explanations seem to be possible:

(1) The corpus allatum has hypertrophied, but is functionless, and for this reason the ovaries remain undeveloped.

(2) There is a mutual influence of the corpus allatum and the ovaries. Some unknown factor has inhibited the development of the ovaries, although the corpus allatum still produces the egg-maturing hormone; but the abnormal ovaries have no effect on the corpus allatum, and so this organ hypertrophies.

If the second hypothesis holds true, removal of the ovaries from newly hatched flies ought to cause a similar enlargement of the corpus allatum as that seen in the abnormal individuals referred to. In this connexion it should be remembered that in some vertebrates castration brings about a considerable increase in size of the pituitary gland, an organ to which the corpus allatum of insects bears some resemblance.

To test this, fifty newly hatched Calliphora females had their ovaries extirpated. Out of these, thirty-one died (the mortality was very high at the beginning, later on I succeeded in lowering it considerably); after seven days at 25° C. the surviving nineteen showed an abnormally large corpus allatum. Out of thirty-five operated controls fourteen died; after seven days at 25° C. twenty showed fully mature ovaries and a considerably smaller corpus allatum than the castrated ones, whereas one fly had abnormal ovaries and correspondingly a very large corpus allatum. All the corpora allata of the castrated females as well as those of the operated controls were examined on living animals and drawn by means of a camera lucida. The areas of the drawings of the individual organs have been calculated and are shown in the two curves of the accompanying graph; to obtain the absolute sizes of the organs these values must be divided by 8,100 as the linear magnification used was 90. It is obvious, as one might have expected, that there is a considerable variation in both groups, but in no case is a corpus allatum from a control as large as a corpus allatum from a castrated female.

These experiments support the second hypothesis stated above. It thus appears that not only does the corpus allatum control the ripening of the ovaries in the normal adult fly, but also the growing ovaries influence the size of corpus allatum, which in the absence of ovaries hypertrophies. As yet the precise nature of this action is obscure. The investigation is being continued.

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Nov. 30.

[1] Wigglesworth, V. B., *Quart. J. Micro. Sci.*, **79**, 91–121 (1936).

[2] Weed, I. G., *Proc. Soc. Exp. Biol. Med.*, **34**, 883 (1936); Weed, I. G., *Anat. Rec.*, **70**, Suppl., 80 (1937).

Bending of Glass under Long Continued Stress

I HAVE tried the following experiment: A piece of optically flat crown glass 3·5 cm. long, and 1·5 cm. broad and 0·3 cm. thick, was supported on wood at the extreme ends, and the middle was loaded with 6 kgm. applied by means of a wooden chisel edge, which carried a weight moving in guides above. It remained in position from April 6, 1938, to December 13, 1939. At the end of that time the glass was taken out and tested on an optical flat by means of interference fringes. It was found to have been bent, the sagitta of the arc amounting to 2·5 bands or 1·25 waves, that is, about 6×10^{-5} cm.

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Scattering of Mesons and the Magnetic Moments of Proton and Neutron

THE meson theory in its present form exhibits a number of difficulties which are connected with the particular way in which the conservation of charge and the spin enter the interaction between mesons and the nuclear particles. The expression for the anomalous magnetic moment of the proton and neutron[1], for example, diverges as $\int_0^\infty dk$. The cross-section for the scattering of mesons by a nucleus is found to be very much larger than experiments permit and increases rapidly with increasing energy. This would be incompatible with the high penetrating power of cosmic ray mesons. The cross-section for scattering of a longitudinal meson (rest mass μ) with energy ε (momentum p/c) is, according to the present theory, given by[2]

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \frac{p^4}{\varepsilon^2(\mu c^2)^2} \qquad (1)$$

From the analogy of mesons with light quanta, one would expect a cross-section of the order $(g^2/Mc^2)^2$, where M is the mass of the proton, and no increase with energy for $\varepsilon > \mu c^2$. The experiments by J. G. Wilson[3] have shown that the scattering cross-section even for an energy so low as a few times μc^2 (10^8 ev.) is smaller than (1) by an order of magnitude and does not increase with energy.

As can be seen from the computation of (1), both difficulties are due to the fact that the conservation of charge forbids a number of transitions which could occur if mesons were neutral particles[3]. A neutral meson could, for example, be *emitted and absorbed* by a proton. A positive meson can *only be emitted by a proton but not absorbed.* The cross-section for scattering would be of the right order of magnitude if we allow a positive meson also to be absorbed and a negative one to be emitted by a proton, etc., or, in other words, if 'proton states' with charges $-e$ and $+2e$ existed[4]. The introduction of those particles meets, however, with the following difficulties. First, particles of this nature are not observed and are unlikely to have escaped observation if they occur in heavy nuclei. Secondly, if a proton were capable of emitting also a negative meson, the negative meson would give a contribution to the anomalous magnetic moment of the proton of opposite sign and—all other quantities being equal—of the same value as the contribution from the positive meson. Thus, there would be no anomalous magnetic moment at all.

These difficulties can be overcome if we assume that the rest mass of the new particles is considerably *higher* than that of the proton, say, by 25–50 electron masses (see below). The particles would then be extremely unstable and would not play any part in the structure of heavy nuclei. Denoting the mass difference between the new particles and the proton by ΔM, the cross-section for the scattering of a longitudinal meson becomes, for $\varepsilon < Mc^2$, assuming $\Delta M \ll \mu$,

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \left\{\frac{1}{3}\left(\frac{\mu}{M}\right)^2\left(\frac{\mu c^2}{\varepsilon}\right)^4 + \left(\frac{\Delta M}{\mu}\right)^2\frac{p^4}{\varepsilon^4}\right\}. \qquad (2)$$

This expression does *not* increase with energy for $\varepsilon > \mu c^2$. If p is approximately μc^2, (2) is smaller by a factor $(\Delta M/\mu)^2$ than (1). A value $\Delta M/\mu$ of approximately 1/5 would be sufficient to bring (2) into harmony with the experimental requirements. For ε greater than Mc^2, φ will probably decrease owing to the relativistic features of the proton.

Similar considerations must be applied to the spin. The spin contributes also to the high scattering cross-section (for transverse mesons). This can be avoided if we introduce also 'higher spin states', for example, heavy particles with spin s of 3/2. Transitions from the normal proton state, s equal to 1/2, to these higher states under the influence of a meson field can be included in the theory in a very simple manner. In the present theory the spin-dependent interaction between a meson field φ and a nuclear particle is f/λ (σ curl ϖ), where σ is the spin matrix and has only matrix elements for $\Delta s = 0$. σ has to be extended in such a way as to include transitions $\Delta s = 1$. This can be done if we replace σ by the matrix of a dipole moment $\mathbf{r}/r$. For transitions $\Delta s = 0$, the matrix elements of $\mathbf{r}/r$ and of σ are identical. If this is done, the cross-section for the scattering of transverse mesons also is small and of the order of magnitude (2). The physical significance of $\mathbf{r}/r$ is that of the *intrinsic* magnetic dipole moment of the proton, which is a characteristic feature of the meson theory ($\mathbf{r}$ is not, of course, the spacial position of the proton).

As a further result of our new assumptions, the anomalous magnetic moments diverge only *logarithmically*. Such a divergence can, at the present stage of the theory of the meson, scarcely be considered as a very serious difficulty. The relativistic features of the proton have so far been neglected, and it may well be that the logarithmic divergence would disappear if they are taken into account properly. As an upper limit for the validity of the meson theory in the form proposed above, we therefore take the rest energy of the proton. The anomalous magnetic moment of the proton then becomes (in units of the nuclear magneton μ_0)

$$\frac{\mu}{\mu_0}=\frac{16}{3\pi}\,\frac{M\,\Delta M}{\mu^2}\,\frac{f^2}{\hbar c}\left(\log\frac{2E_m}{\mu c^2}-\frac{4}{3}\right),\quad E_m\sim Mc^2. \quad (3)$$

This is of the right order of magnitude when $\Delta M/\mu$ is approximately 1/5, which is the value assumed above.

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Nov. 28.

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[1] Fröhlich, Heitler and Kemmer, *Proc. Roy. Soc.*, A, **166**, 154 (1938). Yukawa, Sakata and Taketani, *Proc. Math. Phys. Soc. Japan*, **20**, 319 (1938).

[2] Heitler, *Proc. Roy. Soc.*, A, **166**, 529 (1938), and Report of the Eighth Solvay Conference, Brussels, in the press, where the reasons for the high cross-section are analysed.

[3] Wilson, *Proc. Roy. Soc.*, in the press. I am very much indebted to Dr. Wilson for having sent me his MS. before publication.

[4] This possibility was first mentioned to me by Bhabha in a private discussion in connexion with his classical theory for neutral mesons. The whole problem was very much clarified in discussions with Bhabha, Fröhlich and Kemmer.

A Simple Rule for Evaluating Atomic Constants

FROM some of the fundamental constants, natural units can be formed, showing simple relations among many other constants[1]. The fine structure constant is the well-known example

$$\frac{2\pi e^2}{ch}=\alpha=\frac{1}{137} \quad . \quad . \quad . \quad (1)$$

Also α gives a simple relation between the velocity of the electron in the normal hydrogen atom and the velocity of light, and that between the radius of the electron and of the hydrogen atom in the normal state:

$$\frac{v_e}{c}=\alpha,\ \frac{\gamma_e}{\gamma_{\mathrm{H}}}=\alpha^2.$$

Now let us consider the two following length units: one is for charged particles, and the other for uncharged particles:

$$\frac{e^2}{m_e c^2}\equiv l_c \quad . \quad . \quad . \quad (2) \qquad \sqrt{\frac{Gh}{c^3}}\equiv l_u \quad . \quad . \quad . \quad (3)$$

The ratio of these two,

$$l_c/l_u=\frac{e^2}{m_e\sqrt{Gch}}\equiv A, \quad . \quad . \quad . \quad . \quad (4)$$

will be shown to play a similar part to α. In order to show that, let us employ the de Broglie wave equation in a wide sense.

$$\frac{h}{m_0 c}=l_{\mathrm{max.}} \quad \text{and} \quad \frac{h}{M_{\mathrm{max.}}}=l_0, \quad . \quad . \quad . \quad (5)$$

where the subscripts max. and 0 denote respectively the maximum and minimum mass or length.

From (3) and (5)

$$\frac{l_u^2}{l_0}=\frac{M_{\mathrm{max.}}\,G}{c^2}, \quad . \quad . \quad .$$

which is also a length.

Comparing this with the well-known equation showing the relation between the mass and the radius of the universe, $\frac{M_u G}{c^2}=\frac{\pi}{2}R$,

we may write

$$\frac{l_u^2}{l_0}=\frac{M_u G}{c^2}=l_{\mathrm{max.}}, \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where $M_{\mathrm{max.}}$ and $l_{\mathrm{max.}}$ are identified with the mass of the universe M_u, and the longest distance in space, $\pi R/2$, respectively.

It is interesting to find the numerical coincidence in the two following cases:

$$\frac{M_u}{m_0}=2A^6 \quad . \quad . \quad . \quad (7); \qquad \frac{M_{\mathrm{H}}}{m_0}=3A^2 \quad . \quad . \quad . \quad (8)$$

M_{H} denotes the mass of a hydrogen atom.

From (7) and (8)

$$\frac{M_u}{M_{\mathrm{H}}}=\tfrac{2}{3}A^4=N=136\times 2^{256}, \quad . \quad . \quad . \quad (9)$$

N being the total number of particles in the universe[2].

From (5), (6) and (7)

$$\frac{l_{\mathrm{max.}}}{l_c}=\sqrt{2}A^2 \quad . \quad . \quad . \quad . \quad . \quad (10)$$

From (2), (3), (6), (9) and (10)

$$\frac{M_{\mathrm{H}}}{m_e}=\frac{3}{\sqrt{2}}\,\frac{ch}{e^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Furthermore, the Rydberg constant,

$$R_\infty=\frac{2\pi^2 m_e e^4}{ch^3} \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

With any three constants given, we can thus evaluate the rest. Now let us assume the experimental values of c, R_∞ and G, which are comparatively reliable[3].

$$\left.\begin{aligned} c &= (2{\cdot}99774 \pm 0{\cdot}00005)\,10^{10}\ \text{cm./sec.}\\ R_\infty &= (109{,}737{\cdot}42 \pm 0{\cdot}06)\ /\text{cm.}\\ G &= (6{\cdot}658 \pm 0{\cdot}001)10^{-8}\ \text{cm.}^3/\text{gm.sec.}^2\end{aligned}\right\} \quad . \quad . \quad (4)$$

Then we can find the values of h, e, m_e and M_{H} as follows: The value of A is found in (9) to be $6{\cdot}9715\times 10^{19}$, which is an absolutely definite number.

From (1), (4) and (12),

$$h=\left[\frac{c^3}{16\pi^2 R_\infty^2(137)^6 A^2}\right]\frac{1}{G}=\frac{K_1}{G} \quad . \quad . \quad (13)$$

From (1),

$$e^2=\left[\frac{c}{2\pi 137}\right]h=K_2 h \quad . \quad . \quad . \quad . \quad (14)$$

From (4),

$$m_e=\left[\frac{1}{A\sqrt{Gc}}\right]\frac{e^2}{\sqrt{h}}=K_3\frac{e^2}{\sqrt{h}} \quad . \quad . \quad (15)$$

From (1) and (11), $M_{\mathrm{H}}=[3\sqrt{2}\times 137]\,m_e=K_4 M$.

The results agree closely with the experimental values as shown in the accompanying table.

Constant	Calculated value	Observed value[5]
h	$6{\cdot}6213 \times 10^{-27}$ erg. sec. ± 10	$6{\cdot}6189 \pm 36$ $\times 10^{-27}$ erg. sec. $6{\cdot}6242 \pm 10$ $6{\cdot}6133 \pm 34$
e	$4{\cdot}8019 \times 10^{-10}$ E.S.U. ± 7	$4{\cdot}8025 \pm 4$ $\times 10^{-10}$ E.S.U.
m_e	$9{\cdot}099 \times 10^{-28}$ gm. ± 1	$9{\cdot}1070 \pm 14$ $\times 10^{-28}$ gm. $9{\cdot}1073 \pm 24$ $9{\cdot}0171 \pm 14$
M_H	$1{\cdot}6614 \times 10^{-24}$ gm. ± 2	$1{\cdot}6617 \pm 17$ $\times 10^{-24}$ gm.
e/m	$1{\cdot}7605 \times 10^{7}$ E.M.U./gm. ± 2	$1{\cdot}7591 \pm 2$ $\times 10^{7}$ E.M.U./gm.
h/e	$1{\cdot}3788 \times 10^{-17}$ erg. sec./E.S.U. ± 2	$1{\cdot}3761 \pm 6$ $\times 10^{-17}$ erg. sec./E.S.U. $1{\cdot}3782 \pm 7$ $1{\cdot}3773 \pm 1$ $1{\cdot}3771 \pm 7$

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[1] Eddington, "New Pathways of Sciences".

[2] Eddington, "Relativity Theory of Protons and Electrons".

[3] Bond, *Phil. Mag.*, 624 (1936).

[4] Michelson, *Astrophys. J.*, 82, 26 (1935).

[5] Dunnington, *Rev. Mod. Phys.*, (11), 78 (1939).

Landau Diamagnetism and the Fermi-Dirac Energy Distribution of the Metallic Electrons in Graphite

IT was discovered by Landau[1] that an electron gas should have, besides its spin paramagnetism, an appreciable diamagnetism due to the quantized orbital motions of the electrons in the magnetic field. If the electrons are *free*, the diamagnetic susceptibility per unit volume of the gas, when it is non-degenerate, is given by the Curie law

$$K = -\frac{n\mu^2}{3kT}, \qquad (1)$$

and when it is completely degenerate by the temperature-independent value

$$K = -\frac{n\mu^2}{2kT_0}, \qquad (2)$$

where n is the number of electrons per unit volume, μ is the Bohr magneton, T_0 is the degeneracy temperature defined by

$$kT_0 = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}, \qquad (3)$$

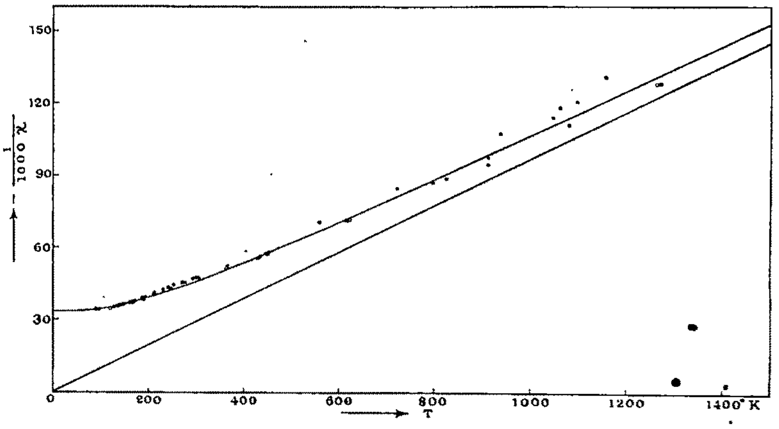
and the other letters have their usual significance. For such a gas the paramagnetic susceptibility is numerically three times the diamagnetic susceptibility and therefore predominates.

For the electrons in any actual metal, which are under the influence of the lattice field, the expressions for the two susceptibilities are naturally more complicated. In particular, the 3 : 1 ratio between them does not hold, and under special conditions the paramagnetic part of the susceptibility may become negligible in comparison with the diamagnetic part. When further, as in graphite, the metallic electrons can move about freely in a plane, and the freedom of movement is confined practically to the plane, the susceptibility along the normal to the plane will conform to equation (1) at high temperatures, and to (2) at low temperatures, the degeneracy temperature T_0 appearing in (2) being, however, much smaller than that given by (3) for electrons that are free to move in all directions.

These results have been verified in graphite. Its abnormal diamagnetism, which is confined to the direction of its hexagonal axis, conforms to equation (1) at high temperatures, and to (2) at low temperatures, with n corresponding to *one electron per carbon atom*, and $T_0 = 520°$ K.; at all temperatures (in the range investigated) the susceptibility per carbon atom is found to be the same as the diamagnetic susceptibility per electron of a Fermi free-electron gas the degeneracy temperature of which is 520° K. The theoretical values for the specific susceptibility (per gram) of graphite, χ, calculated on this basis, are represented by the accompanying curve, and it will be seen that the experimental values, which are denoted by circles, lie close to the curve[2]. The straight line which the curve tends to reach asymptotically at high temperatures is also drawn in the graph, and corresponds to equation (1).

That one electron per carbon atom should be free to move about in the basal plane agrees with the known structure of graphite. There is a Brillouin zone which can just accommodate 3 electrons per atom, which is a flat hexagonal prism bounded by {000,2} and {2$\bar{1}\bar{1}$,0}, and the energy discontinuities across all the faces of the zone are large. There is a bigger zone bounded by {000,2} and {2$\bar{2}$0,0} which can just contain 4 electrons per atom, but the energy discontinuity across {2$\bar{2}$0,0} is small.

The agreement between the experimental data and the theoretical curve plotted in the graph may be regarded as a convincing demonstration of Landau's value for the diamagnetism of a free-electron gas,



and of its temperature variation in accordance with the statistics of Fermi and Dirac.

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Indian Association for the
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Calcutta.
Oct. 21.

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[1] *Z. Phys.*, 64, 629 (1930).

[2] The theoretical curve was plotted with the help of the tables for the Fermi–Dirac integrals given by Stoner, *Proc. Leeds Phil. Soc.*, 3, 403 (1938). The experimental values are from the measurements by Krishnan and Ganguli, *Z. Krist.*, A, 100, 530 (1939), and some unpublished measurements by Ganguli.

Total Solar Eclipse of October 1, 1940

THE Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society has for some years plans prepared for a number of expeditions to observe, what should be a very good eclipse for study, the total eclipse of October 1, 1940. Prof. J. A. Carroll was to have gone from Aberdeen to Brazil with an objective interferometer and an echelon spectrograph for a study of coronal and chromospheric line contours and wave-lengths. The Royal Observatory, Greenwich, and the Cape Observatory were to have gone to Calvinia for a study of the Einstein displacement of stellar images, for a spectrographic study of the chromosphere with a moving-plate camera and for other work. Prof. H. Dingle was to have gone to a station near the edge of the belt of totality for work on wave-lengths and intensities of chromospheric lines near the cusp. The Solar Physics Observatory and the Radcliffe Observatory, Pretoria, were to have joined forces at Nelspoort for a programme including work on the extreme ultra-violet spectrum of the chromosphere and corona, a study of chromospheric line intensities at different heights with a camera having a plate moving intermittently, and polarization studies of the corona and of the sky close to the eclipsed sun.

The outbreak of the War has caused the abandonment of all the expeditions from Great Britain, and the Committee has decided to concentrate on one expedition from the Cape and Radcliffe Observatories to Calvinia. This will carry out as much as proves practicable of the programmes of the various expeditions originally planned. Just how much that will amount to remains to be settled, but every effort will be made to secure as wide a programme of observations as possible.

F. J. M. STRATTON.
(Secretary).

Joint Permanent Eclipse Committee of the
Royal Society and the Royal Astronomical Society,
Gonville and Caius College,
Cambridge.

Points from Foregoing Letters

A. I. Virtanen and M. Torniainen suggest that the discrepancies in their results and those of others experimenting on the excretion of nitrogen compounds from leguminous roots may be ascribed to the quality of the containers, and especially to their porosity. Observations show that the pots giving best results should be large and very porous.

The effects of alkaline reagents on wool have been reviewed by M. R. Freney and M. Lipson. They find that the sulphur and nitrogen contents of merino wool are scarcely altered by immersion in 52 per cent sodium hydroxide up to 30 minutes; that the surface structure of the fibre is unaltered by similar treatment up to 5–10 minutes; that wool treated with concentrated sodium hydroxide absorbs acid dyes evenly; and that a woven fabric treated with 52 per cent sodium hydroxide solution shows a decrease in shrinkage on washing. These studies were extended to treatment of wools with alkalis dissolved in certain organic solvents.

H. Blaschko describes experiments on the inhibition of amine oxidase by derivatives of β-phenyl-*iso*propylamine; it is shown that there exists a parallelism between the awakening action of these drugs and their inhibitory effects on the enzyme.

A. Polson describes and illustrates an apparatus for studying the mobility of animal viruses and their neutralizing antibodies in an electric field. It is a simplified and less complicated modification of the Tiselius moving boundary method.

Ellen Thomsen finds that maturation of the ovaries in adult female flies is controlled by a hormone produced by the corpus allatum, since extirpation of the corpus allatum of young Calliphora and Lucilia females causes the ovaries to stop development at an early stage, whereas operated controls have fully developed ovaries. The ovaries on the other hand influence the corpus allatum, for removal of the ovaries of young Calliphora causes a considerable enlargement of the corpus allatum.

Lord Rayleigh has been able to detect by an interference method a slight permanent set of a strip of glass exposed for many months to a powerful bending moment.

W. Heitler points out that a number of difficulties (diverging magnetic moment of proton, large scattering cross-section for mesons) are due to an inadequate treatment of the spin and charge. It is suggested that 'higher proton states' with charge $2e$, $-e$, and those with spin 3/2 might exist with a rest mass of 25–50 electron masses higher than that of the proton. The cross-section for the scattering of mesons is then of the right order of magnitude and the magnetic moment of the proton diverges only logarithmically.

According to K. S. Krishnan, the abnormal diamagnetism of graphite along its hexagonal axis is the same as the Landau diamagnetism of the Fermi electron gas containing one electron per carbon atom and having a degeneracy temperature of about 520° K.

RESEARCH ITEMS

Osage Warfare

THE late Francis La Flesche, himself an Omaha Indian and a member of the staff of the Smithsonian Institution, Washington, among his numerous studies of the American Indians, made an elaborate record of the rites and ceremonies observed by the Osage Indians in connexion with the conduct of tribal warfare (*Bull. Bureau American Ethnol.*, No. 101, 1939. Washington, D.C.: Government Printing Office, 35 cents). Before taking any action against an enemy, a council meeting was held to choose a leader. This leader had to fast for seven days, and then three complicated and elaborate ceremonies had to be performed. The rituals making up the Wa-sha-be A-thin or war ceremony comprised twenty-eight separate songs, which, interspersed with processions, ceremonial dances and ancient rites, must be sung at just the right times, in proper order, and by the properly designated singers. The Osage, essentially a peaceful tribe who lived in three separate villages in Oklahoma, had also an elaborate peace ceremony, which was intended not only to promote peace within the tribe, but also with their neighbours. They held the peace ceremony in profound veneration because it was believed that the man who had formulated the rite had received supernatural aid in so doing. Though they were peace-loving, intolerable aggression by a neighbouring tribe would force them to take up arms. At the close of the war ceremony a band of warriors was dispatched to meet the enemy. If victory were achieved the band returned with scalps and prisoners, and victory songs were sung.

Distribution of Ceratium

E. STEEMANN NIELSEN has extended his previous researches (1934) on the Ceratia of the Pacific Ocean ("Die Ceratien des indischen Ozeans und der ostasiatischen Gewässer, mit einer allgemeinen Zusammenfassung über die Verbreitung der Ceratien in den Weltmeeren". Von E. Steemann Nielsen. (Dana-Report No. 17.) Pp. 34. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press, 1939.) 3.50 kr.; 3*s*.). It was originally intended to add those of the Atlantic, but as these have been thoroughly dealt with by the two German Expeditions *Meteor* and *Deutschland* (Peters, 1932, and Schubert, 1937) this was considered unnecessary. It is now possible to give a general survey of the distribution of the three oceans and their neighbouring seas. Charts are given showing the distribution of the dominant species in the Indian Ocean and East Asiatic waters and tables of the horizontal and vertical distribution of all of them, with a review of their distribution in the different regions and the numbers in the Nansen net in the stations poor in plankton. The most striking fact that emerges is the homogeneity of distribution and the absence of geographic races or species. As was noted in the southern Pacific, the author regards the two factors temperature and oceanic-neritic influence as of supreme importance in the determination of the distribution of Ceratia. Schubert (1937) regards salinity as of great significance, but the observations of Peters (1932) in the Atlantic and of Nielsen in the Pacific and in the present work are opposed to this. It is agreed that extreme salinity is of importance; but within the limits shown in the open ocean it has apparently little influence on distribution of the Ceratia. The material came almost exclusively from tropical waters. It is found that all Ceratium species which can live in tropical waters are inhabitants of both hemispheres. The cold-water species are, however, only inhabitants of one of them. *Ceratium fusus*, which is well known from both warm and temperate water, inhabits both hemispheres. In the Antarctic there is the cold-water species *Ceratium robustum* inhabiting the whole region, and in the Arctic *Ceratium arcticum*. Most warm-water Ceratia are common to all three oceans, but there are certain forms of purely tropical species found only in the Indian Ocean and Pacific, or only in the Atlantic. This is especially the case with neritic species. The Indian Ocean and the Pacific represent one region so far as the purely tropical Ceratia are concerned.

Offspring from Artificially Activated Ova

S. PINCUS (*Proc. Nat. Acad. Sci.*, 25, 557–559; 1939), following up his previous report that three litters of rabbits had been obtained from recipients of artificially activated ova, shows by further breeding that the transplanted ova which have been activated give rise to normal offspring without fertilization. For example, eighteen chinchilla ova transplanted after activation into an albino doe, which had been made pseudo-pregnant by pituitary extract, gave rise to two chinchilla females, one of which has been further bred by mating to an albino male, giving a second generation of nine chinchilla and three albino.

Seed Weight in the Tomato

THE weight of the seed and embryo in the tomato is dependent on the genotype of the plant, the external environment in which the fruits develop, and also upon certain internal factors such as the number of seeds developing in the fruit and the number of fruits on the truss. L. C. Luckwill (*New Phytol.*, 38, 181–189; 1939) has calculated correlations and regressions between seed weight and these internal factors, and has estimated that variations in seed number may be responsible for variations in mean seed weight as large as 45 per cent. The maximum variation due to differences in the number of fruits developing on the truss was estimated at 10 per cent of the mean. It is suggested that these correlations may arise from causes connected with the nutrition of the developing ovules similar to those which give rise to the negative correlation between birth weight and litter size in certain mammals. These results have a great influence on the design of experiments on heterosis (see also NATURE, Nov. 25, p. 908).

Heterochromatin in the Chromosomes of Drosophila

B. P. KAUFMANN (*Proc. Nat. Acad. Sci.*, 25, 571 577; 1939) has studied the distribution of 627 breaks due to X-rays in the *X*-chromosome of *Drosophila melanogaster*. He shows that there is no difference in frequency or distribution of breaks near or in an inversion as compared with wild-type chromosomes.

There is a significant increase of breaks in certain regions of the chromosome, particularly the known heterochromatin region, and in sections of the euchromatin part. From this and other evidence it is shown that the increased frequency of breaks in the sections of euchromatin is due to the presence of intercalary heterochromatin material.

Interxylary Cork

A PAPER in *Lloydia* (see p. 24 of this issue) by R. A. Diettert upon the morphology of *Artemisia tridentata* directs renewed attention to this interesting phenomenon. When annual growth recommences in the stem in the spring a single layer of meristematic cells, the interxylary phellogen, remains on the surface of the last-formed xylem of the previous year. Quite late in the summer, in July and August, these initials give rise to several layers of cells which suberize progressively in a centrifugal direction. As a result the wood of the current season is carried out on to a wider periphery by this late cork development; the rays are thus expanded and also the cells of the rays, in the region of the cork layer, are suberized progressively in an outwards direction. We thus have the most recently formed layer of wood cut off from all older layers of wood by a sheet of periderm, a process that is repeated in successive years. This must have a most important effect upon the water economy of the plant, which has a wide distribution throughout the western United States. E. H. Moss has directed attention previously to the presence of such rings of cork in herbaceous perennials (NATURE, **133**, 689; 1934), concluding that they afford excellent protection against desiccation and various deleterious effects that might be associated with the dying down of annual shoots.

Softening of Rubber

CRUDE raw rubber as received by manufacturers has to be reduced by heating and mechanical working to a soft plastic condition to permit incorporation of the essential compounding ingredients. Experiments have been carried out by V. H. Wentworth and J. D. Hastings at the Rubber Research Institute of Malaya (*J. Rub. Res. Inst. Malaya*, **9**, Comm. 236 and 237) to determine if softening could not be more economically effected by modifying the preparation of the rubber on the plantation. A promising line of attack is the treatment of latex prior to coagulation with substances such as zinc soaps which bring about softening in the course of the normal smoking and drying processes. Pine tar is an effective softener in common use, and in view of the fact that it was found possible to incorporate large quantities into the latex, it is suggested that master-batch preparation on estates might be worthy of consideration by the manufacturers. The incorporation of emulsions of 'peptizing agents' into the latex in the pre-coagulation stage is another method which has been used during the last two years for softening purposes. It is now shown that the degree of softness achieved depends to a large extent on the temperature at which the wet sheet is afterwards dried, high temperature in the early stages assisting the softening markedly.

Control of Loose Smut Disease

THE original delicate method of controlling the loose smut fungi upon wheat and barley by dipping the seed in hot water for a short period has gradually given place to the more workable treatment of steeping for a longer time at a lower temperature. G. Howard Jones has designed an automatic apparatus for dealing with the seed on cereal improvement farms in Egypt (*Min. Agr. Egypt Tech. and Sci. Service Bull.* 220. Govt. Press, Bulâq, Cairo, 1939. P.T. 3). About 150 lb. of seed contained in a hopper is emptied into a wire basket within a heating bath by means of an automatic electric relay control apparatus which also switches on the heating units. Six hours later, the same apparatus rings an alarm; the wire basket is then hoisted from its bath and the seed spread upon trays to dry in the sun. The heating is accomplished during the night, so that full advantage may be taken of the drying effect of the sun, and thus a continuous series of daily treatments is maintained. Germination is affected to a slight, but commercially insignificant, extent by the process.

The Ogasima (Japan) Earthquake of May 1

THIS is the subject of three papers by T. Hagiwara, N. Miyabe, R. Takei and Y. Otuka (Earthquake Research Institute, Tokyo Imperial University, 17, Part 3, September 1939), who have studied respectively the shock and aftershocks, the deformations of the earth's surface and the geological implications. The earthquake occurred about 14h. 58m. on May 1, 1939, and shocks of the same magnitude followed twice with an interval of two minutes, in the neighbourhood of Ogasima and the neck of a small peninsula in the Akita Prefecture. The aftershocks which followed the main earthquake were observed by four portable seismographs installed temporarily in the peninsula, and these aftershocks were found to have had epicentres near to where the surface effects were greatest within the peninsula, but not all originated in one place. Hundreds of dwelling-houses were destroyed by the earthquake and a landslide which followed it, and 29 people were killed. The surface effects including damage to property, surface cracks and permanent movement were found to be greatest (1) in the neighbourhood of Kitaura-mati on the northern seashore, where also a cliff extending about one kilometre along the Japan Sea slid down to the sea and destroyed more than a hundred houses; (2) near the villages of Anden and Kotogawa where the damage was greatest and surface features most distorted; (3) on the northern slope of Kanpûzan volcano; and (4) in Katanisi-mura, in the narrow isthmus dividing Lake Hatirōgata from the Japan Sea. In several places where the ground was permanently deformed, the horizontal displacements were up to 3·9 m. whilst the vertical displacements ranged about 1 m. Yanosuke Otuka is of the opinion that these displacements were due to surface ground disturbance and that they had no tectonic significance. The landslide however was due to slipping along the bedding plane of the Kitaura sand and mud alternation of the Middle Neogene.

Meteorology of the Byrd Expedition

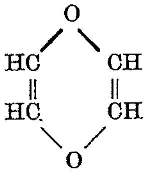
SUPPLEMENT No. 41 of the *Monthly Weather Review* of the U.S. Department of Agriculture, issued last October, is an account running to 377 pages of the meteorological results of the Byrd Antarctic Expeditions of 1928–30 and 1933–35, by C. Grimminger and W. C. Haines. Part of the data had been prepared in the Antarctic in 1929–30 by W. C. Haines and H. T. Harrison. Apart from the introduction, the volume is occupied by the tables in which the meteorological observations are set out. These include the observations made on the various ships of the Expedition between New Zealand and the Bay of Whales, those made at Little America (the base of the Expedition in lat. 78° 34′ S., long. 163° 56′ W., which was at nearly the same spot as "Framheim", where Amundsen obtained 10 months' records in 1911–12) and at the Bolling Advanced Weather Base, which was occupied by Admiral Byrd alone from March 26 to October 11, 1934, and on various sledging journeys. Upper air observations were made with the aid of kites carrying Marvin kite meteorographs. On the first expedition a kite meteorograph was installed on the aeroplane that formed part of the equipment, and on the second expedition an autogyro was taken, primarily for the purpose of making temperature observations, because of difficulties that had been encountered with kites. The best method of mounting the kite meteorograph was found to be that of suspending it within the fuselage to the rear of the cabin on rubber cords, ventilation being secured by having a tube of wind-proof cloth leading from an air vent in the top of the fuselage to the meteorograph. This enabled a perfect record to be obtained on the flight to and from the South Pole. The completeness of the meteorological record under the most trying conditions testifies to the keen work not only of the meteorologists but also of those who assisted, notably the leader of the expedition during his lonely vigil during the whole of an Antarctic winter night less than 10° from the Pole. In spite of difficulties arising from the intense cold, from drifting snow and frosting of the lenses of the pilot balloon theodolites, pilot balloon observations of upper wind were made at Little America on 569 occasions during the 310-day period when the pilot balloon station was in operation on the second expedition. A critical discussion of the results obtained will, it is hoped, be made in due course, although no objection can be made to this early publication of the raw material for such a discussion.

Structures of Ozone and Some Compounds

THE structures of ozone, silicobromoform ($SiHBr_3$) and dichlorogermane (GeH_2Cl_2) contain contributions from several forms among which resonance exists. The dipole moments of these substances have been measured by G. L. Lewis and C. P. Smyth (*J. Amer. Chem. Soc.*, 61, 3063; 1939), ozone being measured in solution in liquid oxygen, silicobromoform in heptane and dichlorogermane in carbon tetrachloride. The moments (in usual units) are O_3, 0·49; $SiHBr_3$, 0·79; GeH_2Cl_2, 2·21. The finite moment of ozone excludes the symmetrical triangular molecule in which each atom is linked to two others by a single bond. A linear molecule with a central atom joined to one on each side by identical bonds is also excluded. A bent structure, analogous to that of sulphur dioxide, seems indicated. The electronic structures which seem likely to the ground state of the molecule are the following: $:\ddot{\mathrm{O}}::\overset{+}{\ddot{\mathrm{O}}}:\overset{-}{\underset{\cdot\cdot}{\ddot{\mathrm{O}}}}:$ $:\overset{-}{\underset{\cdot\cdot}{\ddot{\mathrm{O}}}}:\overset{+}{\ddot{\mathrm{O}}}::\ddot{\mathrm{O}}:$ $:\overset{+}{\ddot{\mathrm{O}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:$ $:\overset{-}{\underset{\cdot\cdot}{\ddot{\mathrm{O}}}}:\underset{\cdot\cdot}{\ddot{\mathrm{O}}}:\overset{+}{\ddot{\mathrm{O}}}:$ and the first two, in which each atom has a complete octet of electrons, should make the largest contribution. All these structures are bent, the O—O—O angle being not less than 120°. It is concluded that the two oxygens linked to the central atom form an angle of about 140° and in any case very obtuse. The two identical bonds have some polar character as a result of resonance among forms containing semi-polar bonds. The results for silicobromoform and dichlorogermane show that silicon compounds tend to have minimum moments in the group of carbon, silicon, germanium and tin compounds, which, otherwise, increase in the order named.

Dioxadiene

THE compound used as the fundamental or parent nucleus for dioxane, dioxene and their derivatives, namely:



previously called dioxin, has now been prepared for the first time by R. K. Summerbell and R. R. Umhoefer (*J. Amer. Chem. Soc.*, 61, 3020; 1939) and called dioxadiene. It was obtained by the action of magnesium and magnesium iodide on 2,3,5,6-tetrachlorodioxane in boiling *n*-butyl ether (no reaction occurred in the lower boiling ethyl ether). Other reactions tried did not succeed. Dioxadiene boils at 75°, which is 26° lower than dioxane, it is insoluble in water, and in its chemical properties it behaves generally as an unsaturated ether. It is, however, more stable towards dilute acid than other unsaturated ethers such as dioxene and vinyl ether. It polymerizes in two to three weeks to a hard colourless solid, not melting below 250°, and insoluble in water, benzene, etc. Dioxadiene reacts vigorously with bromine and adds on hydrogen chloride. The reactions indicate that the unsaturation in the molecule is modified to a marked extent by conjugation with the ether oxygens.

Determination of Meteor Velocity from Zenith Attraction

IN a recent paper, Hideo Inouye shows how meteor velocities can be determined by finding the radiants of a shower at fairly short intervals when the radiant is not far from the meridian (*Mon. Not. Roy. Astro. Soc.*, 99, 9; October 1939). The observations are made when the radiant is near the meridian because the effects of the diurnal aberration in displacing the radiant are then negligible. It is well known that the attraction of the earth on a meteor causes a movement of the radiant towards the zenith, and the amount of this movement depends upon the velocity of the meteor and also on the distance of the radiant from the zenith. From the displacement of the radiant when it is at various altitudes an angle θ can be easily found, and from this latter the value of the velocity is read off from a table. An example is given from the Leonid shower of November 13, 1937, and from this the velocity of the meteors associated with this shower is 59·5 km./sec. The actual value is 71·4 km./sec., and it is suggested that this can be explained by errors of observation in the amount of the displacement. Although the method is interesting, it does not lend itself to very high accuracy.

COPROPHAGY IN THE RABBIT

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COPROPHAGY in the rabbit was discussed in NATURE (1939) under the title "Does the Rabbit Chew the Cud ?" and the early observations of Morot (1882)[1] were confirmed by Madsen[2] and by Taylor[3]. These observations showed that two kinds of fæces were voided by the rabbit, the familiar dry pellet type during the day and a soft mucous type during the night, rarely observed because the animal collects them directly from the anus and swallows them again. Madsen suggested that the difference in the two types was due to an intestinal rhythm in the rabbit itself and that refection was a normal physiological process in this animal. Taylor, on the evidence of coccidial oocysts found in the stomach and of experimental feeding with lycopodium spores, agreed with Madsen and emphasized the necessity for recognition of this peculiar attribute of the rabbit in the correct interpretation of parasitological and physiological work in which this animal is employed. In the latter connexion he cited specific experiments of mine on the fate of ingested copper, some of the data of which may be more fully discussed.

In one of the earlier experiments it was observed that the elimination of 50 mgm. of copper (as the sulphate, dried on to food) was spread over five weeks: 22·5 mgm. appearing in the first week, 14 mgm. in the second, 6·4 mgm. in the third, 2·4 mgm. in the fourth and 1·3 mgm. in the fifth week, the remaining 3·4 mgm. being probably accounted for by summation of analytical error over some 35 analyses. Other evidence was available that the retention of such large quantities of copper could not be due to absorption from the alimentary tract and storage within the body with subsequent elimination, and the only rational explanation seemed to be refection of the copper-containing fæces. Since, however, half the quantity of copper finally accounted for was still present in the tract after a week, calculation shows that 80–90 per cent of the total fæces excreted must have been re-eaten, according to the interval assumed for complete passage of food through the tract, or 4–9 times the amount which actually passed through the wire-mesh floor of the cage. Such a high degree of refection seemed incredible even with an animal receiving a quantity of food well below its maximum appetite level.

On repeating this experiment, killing the animal after a week and analysing the contents of the tract, the tract itself as well as the major tissues, 38 mgm. of the copper fed were found to have appeared in the fæces during the week as against 22·5 mgm. in the previous experiment and a further 12 mgm. were found in the contents of the tract (2·5 mgm. in stomach, 1 mgm. in the intestines, 5 mgm. in the cæcum and 3·5 mgm. in the rectum) while the wall of the tract itself and the tissues contained only the usual 0·2–0·5 mgm. per cent fresh material. The high amount of copper found in the stomach contents afforded particularly strong evidence of refection, and calculation from the observed excretion of copper suggested reconsumption of 50–70 per cent of each day's rectal deliveries.

Another experiment with a rabbit provided with a wooden collar, presumed large enough to prevent the animal getting at its anus, was undertaken, and the dry matter and copper fæcal excretion studied. In a five days preliminary uncollared period, an average daily excretion of 9·5 gm. dry matter was observed, of the ordinary familiar pellet type. After attaching the collar, 54·5 gm. dry matter appeared within twenty-four hours, 37·5 gm. being present in the normal 'day' fæces and 17 gm. in the softer 'night' fæces type, consisting of mucous covered agglomerates of much smaller pellets suggestive of loganberries. On the assumption that 9·5 gm. dry matter would also have been obtained on the sixth day but for the collar, the actual appearance of 54·5 gm. suggests that 45 gm. would have been eaten had the animal been able to get at its anus, a calculated 'refection level' of 82 per cent of the total excretion. This is astonishingly high and may perhaps have been accentuated by irregularity of rectal evacuation although there is no reason for such an assumption.

50 mgm. of copper had again been incorporated with the food the day the collar was attached and 96 per cent was recovered in four days: 10 mgm. on the first day, 25·5 mgm. on the second; 6·9 mgm. and 5·7 mgm. on the third and fourth days respectively; the remaining 4 per cent appeared over the next few days. This presumably represents the ordinary rate of passage through the tract, the lag over the third and fourth days probably being explained by the large storage capacity of the cæcum, and is in striking contrast to the behaviour noted in rabbits allowed to practise their customary coprophagy.

Excluding the first day of high fæcal excretion after collaring, the average dry matter over the next fifteen days was 13·7 gm. daily, 4·2 gm. more than in the five uncollared days on the same ration. This at least suggests that refection increases the extent of digestion of the dry matter of the food, and taking the daily dry matter intake as 37 gm., digestion coefficients for the collared period were 63 per cent, and for the uncollared period 77 per cent when the material was passed through the tract several times. As showing the extent of the craving for fæces, after twelve days the rabbit discovered a cunning method of circumventing the collar and was able to secure occasional pellets from the anus although often rolling over in the process.

On replacing the collar by a larger one and again feeding 50 mgm. copper a few days later, 6·5 mgm. appeared within twenty-four hours. The collar was then removed. Less than 4·5 gm. dry matter appeared over the next twenty-four hours and copper recovery diminished although the output of fæcal matter again rose and a further 36·5 mgm. copper were recovered in the ensuing seven days. On again replacing the collar practically all the remaining copper appeared in two days, during the first of which the fæcal dry matter rose from 13 gm. to 28 gm. with the reappearance of 'night' fæces. Again on the assumption that the actual rectal output was the same as on preceding days, the drop of fæcal dry matter actually collected, 13·7 gm. to 4·5 gm., represents a refection of 9·2 gm. or 67 per cent of the total passing the anus. Similarly when the collar was next replaced the rise in fæcal dry matter from 13 gm. to 28 gm. represents a minimum refection of 15 gm. or 54 per cent—the real figure being higher if one assumes a tendency to greater retention in the tract when refection is suddenly prohibited.

Naturally the degree of refection varies with each individual rabbit, with the amount of food, probably with the chemical composition of the food and with disturbance of habit by intermittent collaring. In the last mentioned experiment the refection level apparently varied from 54 to 82 per cent at different periods, and in the first experiment, in which elimination of copper was spread over five weeks, the average daily refection must have exceeded 80 per cent of the total fæces passing the anus.

A further point of interest is the difference in ash content, on a dry matter basis, between 'day' and 'night' fæces on the particular diet employed: 6·5–10 per cent in the 'day' fæces and 11·7–14·5 per cent in the 'night' fæces. Further investigations are in progress regarding other differences in chemical composition and on the relation between time of feeding and the appearance of pellet types.

[1] Morot, Ch., *Mém. Soc. centr. méd. vét.*, **12**, Sér. 1 (1882).

[2] Madsen, H., NATURE, **143**, 981 (1939).

[3] Taylor, E. L., NATURE, **143**, 981 (1939).

CHARITY AND THE STRUGGLE FOR EXISTENCE*

T. H. HUXLEY in his famous Romanes Lecture startled the University of Oxford by saying, or seeming to say, that the cosmic process as represented by the struggle for existence "works not for righteousness but against it". Apparently his contention was that the use of tooth and claw was to be contrasted with the more civilized methods of maintaining the race in being. Huxley, however, did not define the precise function to be attributed to the higher morality as a means of survival. It remains, therefore, for the anthropologist to inquire what actual evidence there is for the view that what is salvation for the brute, or even for the savage, spells damnation for a reasonable being knowing good from evil.

"Real progress is progress in charity, all other advances being secondary thereto"[1]. Huxley himself would have been the first to insist that what he terms ethical process involves 'charity' as a typical manifestation of pure goodness. If 'charity' then be taken as a mark of the spiritual man, how far does a disposition towards it set him at variance with his former self, the natural man?

Now, on the plane of anthropology, Dr. Marett disclaims at once any intention of trying to determine more than the biological function of morality, and in particular that of charity as its crowning grace. This method can at least furnish an external criterion of their worth. On a long view, such as that taken by the anthropologist, it becomes plain that certain types of conduct are of greater biological advantage than others—that they promote the survival of those who live accordingly. Further, they have the advantage that the anthropologist, who must with his evolutionary outlook insist on continuity at all costs, can recognize in man a steadily increasing purpose to make the best of his life, and he cannot but treat primitive and advanced morality as lineally related expressions of the same basic motive.

Charity would seem to be rooted in mother-love, on which the protracted infancy of our species makes it specially dependent; for they both involve a like readiness to give regardless of desert and with no thought of a return. At the same time, having regard to certain tendencies in human nature in virtue of its bi-sexual constitution, justice may be linked with fatherhood, while a certain virtue which may be roughly identified with holiness represents the effort to transcend the psychological opposition between them.

Justice then may be regarded as the outcome of male masterfulness, which in course of time establishes a system of rights and duties having strict reciprocity as its ideal limit. Father-right, however, has prevailed over mother-right in the evolution of the greater society, so that modern civilization is threatened with a type of authoritarian State given over to a harsh legalism insufficiently tempered by mercy. That so one-sided an exploitation of man's spiritual resources is unhealthy is possibly illustrated by the fact that the world's successive civilizations, all alike built up on power politics, hitherto have invariably come to grief.

Family life, however, outlasts the decay of nations; and for the anthropologist, it is suggested, the key to the understanding of human development on its moral side is not so much the evolution of the State as that of the family. In no department of life has experiment played a greater part, though only on the cultural side is this possible, since the biological conditions are virtually fixed. It might even be argued that the whole social process is fundamentally an attempt to resolve the temperamental conflict of sex into a harmony sufficient to ensure the continuation of the species.

Here then in family life lies the best hope of striking a balance between gentleness and firmness in human intercourse.

As for what has here been called holiness, the history of religion shows that there have always been high-minded persons who tended to turn away from sex as too disturbing a factor in the moral life. But to starve by way of sublimating sex can at best be but an indirect way of promoting the survival of the race. It must be left rather to ordinary men and women to make their characteristic but diverse contributions to a morality which will ever consist in a compromise between discipline and love. Such is the two-fold aim of that traditional nurture which has become man's second nature and alone can bring him safely through the ages that lie ahead.

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* Charity and the Struggle for Existence (Huxley Memorial Lecture for 1939). By Dr. R. R. Marett. Pp. 14. (London: Royal Anthropological Institute, 1939.)

[1] "Head, Heart and Hands", by R. R. Marett, p. 40. (London 1935.)

SOME INDIAN ORIGINS IN THE LIGHT OF ASTRONOMICAL EVIDENCE

AMONG recent communications to the Royal Asiatic Society of Bengal, several dealing with details of a technical character in palæographical and historical studies bear upon points of interest and importance in the archæological investigation of the origin and development of Indian civilization*.

In a discussion by S. N. Chakravarti of the development of the Bengali alphabet from the fifth century A.D. to the end of Mohammedan rule, in which the argument depends upon a detailed examination of variations in form, the Bengali alphabet is derived from a proto-Bengali of the tenth century, which in turn it is suggested can be traced back to certain ancient prototypes in the pictographic script of the Indus Valley civilization. It is also suggested that the Indian system of notation, for which affinity with Egyptian demotic has been indicated, is in reality indigenous in origin, probably to be traced back to the seals of the Indus Valley.

Conclusions of a more surprising character, based on astronomical evidence, have been formulated by P. C. Sengupta in a series of papers discussing chronological and other problems in early Indian history. The first of these deals with the date of the Bhārata battle, the great conflict which forms the central incident of that great monument of early Indian literature, the Mahabharata. The date for this battle, as usually accounted, is indicated by three lines of traditional evidence at 3102–3101 B.C. The author, on an examination of one of these traditions, the evidence of the Yudhiṣṭhira era, has shown that the astronomical references justify the inference that the great battle took place in 2449 B.C. He now turns to examine the remaining two traditions, the Āryabhaṭa and the Purāṇic traditions.

The calculation depends upon the dating of the Kaliyuga, which the Mahabharata states had just begun and to which the date February 3102 B.C. is assigned. It cannot, however, be reconciled with the astronomical Kaliyuga, and is shown to be based upon an astronomical calculation in which conditions are correct only for A.D. 499, when the Hindu scientific Siddhantas came into being. It depends upon an incorrect assumption of the position of the solstices of Pandava times and an incorrect annual rate of the precession of the equinoxes. A corrected back calculation from conditions in the heavens corresponding to those recorded in the Mahabharata, that is, conditions in the period February 1924–35, gives a date January 10, 2454 B.C. as the beginning of this Kaliyuga era, and 2449 B.C. as the year of the battle.

This leads to further inquiry as to observation of the solstices in successive ages. This was determined by the phases of the moon in the month of Māgha, a lunar month of which the beginning at the present time may be from January 15 to February 11. In the calendar of the Vedic Hindus, this month started the five-year cycle which began "when the sun, the moon and the Dhaniṣṭhās (Delphinis) cross the heavens together; it is the beginning of the Yuga, of the month of Māgha or Tapas, of the light half and of the sun's northerly course". From the astronomical conjunctions to which reference is made in the Mahabharata, it would appear that this reckoning was started (traditionally by Brahma) at about 3050 B.C.

There are three peculiarities of this month: (1) it began with a new moon near Delphinis; (2) the full moon was near Regulus; (3) the last quarter was conjoined with Antares. Such a month did not come every year, but it was the standard month of Māgha. In our own times it occurred in 1924 during February 5–March 5, a year which for the purpose of this investigation is taken as the gauge year.

References in the Brahmanic and other works directly state or indicate the winter solstice of successive Vedic periods. From these astronomical references fixing the position of the moon in relation to the winter solstice and the beginning of the month Māgha, a matter of ritual importance in connexion with the year-long and other sacrifices, it has been possible to fix by calculation back from the corresponding conditions in recent years a series of dates beginning with 3550 B.C., the earliest date of the age of the Brahmanas, and covering a period of 1,450 years with a possible error of 400 years. It was thus during this period that the Brahmanic literature developed.

Next is considered Madhu-Vidyā, or the "science of Spring" which as here interpreted is really the knowledge of the celestial signal for the coming of spring, addressed to the Aśvins, who are identified with α and β Arietis, the prominent stars in the Aśvini cluster. The three stars, α, β and γ Arietis, form a constellation which is likened to the head of a horse. The Aśvins are spoken of in several passages of the Rig-Veda as riding in the heavens in their triangular, three-wheeled, and spring-bearing chariot.

From certain references it would seem that when the car of the Aśvins first becomes visible at dawn, spring began at some place in the latitude of Kurukṣetra in the Punjab. The jealously guarded Madhu-Vidyā or "science of Spring" was thus nothing but knowledge of the celestial signal of the advent of spring—the heliacal rising of α, β and γ Arietis.

By astronomical calculation it can be shown that this event at the latitude mentioned took place at, say, 4000 B.C. Hence it is beyond question that the Vedic Hindus could find accurately the beginnings of winter, spring and all seasons of the year.

The earliest epigraphic evidence of Vedic chronology from cuneiform inscriptions referring to Indra and other gods of the horse-riding Kharri or Mitanni dates from about 1400 B.C. In the absence of further epigraphic evidence, it is pointed out, this definite finding of the astronomical evidence derived from the literature as to the antiquity and chronology of the Vedas must be allowed to stand. It establishes, it is maintained, that the civilization of the Vedic Hindus was earlier than that of the Indus Valley as evidenced by the remains at Mohenjo-daro.

Finally, in "When Indra became Maghavan", Mr. Sengupta turns to the relation of the Vedic god Indra, the "shedder of rain" and "the wielder of the thunderbolt" to the summer solstice. The references to this god in the Rig-Veda, when divested of all allegory, suggest that he is the god of the summer solstice, while the clouds as represented by a demon are unwilling to yield up their watery store until assailed by the thunderbolt hurled by the god.

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* See *J. R. Asiat. Soc. Bengal, Letters*, 4, 3 (1938); issued September 1939.

The monsoons which bring the rains usually burst about June 22 and there is usually a drought which lasts for about a month before the monsoon comes. The demon Suṣṇa (drought) is killed by Indra. The fight with Vrtra or Ahi, the cloud demon, is thus an annual affair which takes place when the sun enters the summer solstice, Indra withdrawing his rain-giving (or annual) bow with the coming of autumn.

When did Indra become the slayer of Vrtra ? The answer given by the Rig-Veda is when Indra by the rising of Maghas became Maghavan. Maghas to us must be the constellation Maghās consisting of α, η, γ, ζ, μ and ς Leonis, at the heliacal rising of which the sun reached the summer solstice at the latitude of Kuruksetra (lat. 30° N.). This it is shown must have happened in 4170 B.C.

APPLICATIONS OF PHOTOGRAPHY TO ENGINEERING

IN a paper delivered to the Junior Institution of Engineers on November 4 and published in the journal of the Institution for December, Mr. A. H. Styring gives an account of several practical applications of photography to engineering. He lays special stress on infra-red photography, photography by polarized light, X-ray photography and high-speed photography.

Infra-red sensitive materials have proved of the greatest value in spectroscopy and astronomy. Photographs of the solar spectrum have revealed lines as far as 13,500 A. wave-length. Distance appears hazy on non-colour sensitive materials because the suspended particles of water vapour in the atmosphere, which are transparent and therefore affect vision only slightly, act as a thick medium for deep violet and ultra-violet waves, scattering them, and producing an effect similar to that which would be seen if we were to try to look through a sheet of finely ground glass.

When photographing at great distances, the best results are obtained with infra-red sensitive materials and filters. Infra-red waves are less easily scattered by water and dust particles in the intervening atmosphere than are the shorter rays in the normal visibility range. The power of haze penetration is important and has an engineering application. Research is in progress for the adaptation of infra-red sensitive materials for navigational purposes. Good work has been done up to six miles, and distances up to twenty miles have been claimed. Special infra-red cameras have been fitted to trans-Atlantic liners in which infra-red film is exposed at 20-second intervals, each picture being developed and fixed rapidly for viewing in roughly one minute. In the same way application has also been made for military purposes, permitting vision of objects invisible to the eye. Other applications depend mainly on the fact that many dyes and pigments, which absorb strongly in the visible region, either transmit or reflect freely in the near infra-red region. In consequence it is possible to reveal by infra-red photography many structures invisible to the eye, and to differentiate between materials which to the eye appear similar. This has a useful application in photomicrography. Another promising field lies in the direction of research in the realm of elevated temperatures. Heat rays are recorded by infra-red materials.

Polarized light photography is based on the fact that light reflected from a non-metallic surface at an angle of 32–37° is strongly polarized. At other angles except 90° it is to variable extents. For this reason the reflection from natural things, separately and combined, has much of the light polarized. The unaided eye fails to detect this, but many objects viewed by a polarizing screen assume a new and strange beauty. The use of polarized light in photography is made possible by the way in which all natural substances reflect polarized light. When a ray of light falls on a sheet of paper, for example, the light that is reflected is composed of two parts, which are called 'specular' and 'diffused' components. The specular component produces 'gloss' and enables us to see more or less distinctly an image of the source of light. If we look at our object through a polarizing screen, we find that we can orient the screen so that practically all the specular reflection is stopped and we see the object by diffusely reflected light. Polarizing screens have recently been made from a quinine-iodine compound called 'Herapathite', a thin layer of the substance being cemented between two sheets of plane glass. The use of such a screen permits photographs to be taken obliquely through water or glass.

The principal application of X-rays to industry is the examination of articles during manufacture. Increased penetration is constantly being achieved and the definition of radiographs has been greatly improved. It does not necessitate expensive castings or forgings being either sawn asunder or otherwise destroyed or mutilated. With a little experience, defects such as gas cavities, sand and slag inclusions, metal segregation, etc., can be easily detected. The atomic weight of the substance examined has a marked effect on the depth of penetration of the rays. Apart from this fact, penetration depends on the voltage applied to the tube. For example, 40,000 volts will penetrate 4 in. of aluminium, but it requires 250,000 volts to penetrate 4 in. of steel. The gamma radiations of radioactive substances have latterly been employed for the same purposes as X-rays. Owing to their shorter wave-length the gamma rays have a much greater penetrative power.

The author points out that with high-speed photography, the ordinary type of motion camera which has an intermittent film motion and shutter can only be speeded up to ten times its normal speed before rupture takes place. Cameras operating at higher speeds have continuously moving films. In the mechanism of the high-speed camera perfected by the Western Electric Co. and Kodak Ltd. there is incorporated a clock, and this records the exact time when each event in a cycle takes place.

FLUID FILLING-MEDIA FOR ELECTRICAL APPARATUS

THIS paper, written by F. Meyer of the General Electric Co., was allocated for reading to the Institute of Electrical Engineers on November 23 and is now published. The author discusses the everyday fluid insulators used for electrical apparatus, particularly with transformers, and advances suggestions for improving the British Standard Specification (148, 1933, Insulating Oils for Electrical Purposes). In addition he discusses the properties of chlorinated diphenyls, perhaps the commonest non-inflammable liquids used for this purpose, which are known in America under the technical name 'pyranol'. The particular requirements of oils suitable for condensers are also considered.

When oil was first adopted for filling transformers and switchgear, use was made of the best existing kind of oil. Going back no farther than thirty years ago, we find that oils were fully approved that would now be instantly rejected, both with regard to their electrical properties and their other physical characteristics. In successive editions of the British Standard Specification 148, the requirements have been tightened up until the oil which satisfies Spec. 148 could be safely used medicinally. Unfortunately the demand of the transformer manufacturers was for an oil based on its sludge value and tested by a method far removed from service conditions, and very little attention was paid to its other properties. It is a well-known fact that the oxidation products of an oil at 150° C. are very different from those taken at 90° C. both in quantity and character. As a test for the eradication of unsuitable oils the author thinks that the Michie test has outgrown its original use.

Fifty per cent of the transformer oil used to-day is Grade *A* oil, typical examples of which give practically zero sludge values. For switchgear purposes where sludge is of small importance, highly refined oil is quite unnecessary. The less refined also the oil the cheaper it is, a point of importance when we consider the large bulk of oil used. Class *B* oils, which formerly were just obtainable with sludge values between 0·7 and 0·8, are to-day readily procurable at the low figure of 0·3 or even less. The author points out that in bringing the sludge value of oils down to these low limits the danger of the development of acidity is now as menacing as the old danger of high sludge values was. It may well be that in the light of modern experience, the highly refined *A* oils employed so widely to-day which have practically zero sludge value will be discarded and an oil of a moderate degree of refinement, but low developed acidity, will become the standard of transformer oil. Tests of *A* and *B* oils taken over a period of six months show that the rate of acidity increases for both oils, for the first three months is much the same but for the next three months the average acidity of the *A* oil increases much more rapidly than the *B* oil.

The greatest drawback of oil as a filling medium is its inflammability. In consequence of recent disastrous fires at Bradford and Kingston due to the oil in transformers and switchgear, and also the danger of fire from incendiary bombs, engineers have been recently studying closely the only non-inflammable liquids at present available, that is, synthetic chlorinated compounds. The commonest of these are the chlorinated diphenyls made in America and on the Continent but not yet manufactured in Great Britain. The degree of inflammability of pure chlorinated diphenyl, generally called in Great Britain 'aroclor', depends on the degree of chlorination. Experiments demonstrate not only the non-inflammability of 48 per cent chlorinated aroclor but also that, in addition, it has the valuable property of acting as a fire extinguisher.

In conclusion, the author discusses condenser oils, which are generally pure mineral hydrocarbon oils. Service conditions in this case are so severe that they cannot be used as delivered by the oil refiners, which can safely be done with transformers.

ROAD SURFACE TEXTURE PRINTS

THAT surface texture is an important factor in determining the resistance of a road to skidding has long been recognized, and at the Road Research Station one of the studies which has received attention has been the development of a satisfactory method of recording this quality. The latest device is an adaptation of the method of offset printing, and it is also the simplest and the most revealing in that it readily lends itself to a study of the changes which occur during the life of the road carpet and of its progress towards failure. A few square inches of the road under examination are cleaned of dust and then carefully inked over either by an ordinary half-tone black printing ink diluted with paraffin or by a water letterpress ink. A clean rubber roller, of specified hardness, is then run over the inked area and the impression taken by the roller is transferred to a sheet of white paper.

The prints which are obtained in this way are remarkable for the wealth of detail which they exhibit, even the finest particles on the surface, about a thousandth of an inch in diameter, being recorded. A Bulletin—Road Research Bulletin No. 3 ("A Printing Method of Recording Road Surface Texture". H.M. Stationery Office. 9*d*.)—just issued by the Department of Scientific and Industrial Research and the Ministry of Transport; gives a description of the process and of the apparatus which, it may be mentioned, packs into a suit-case. It exhibits a number of reproductions of prints taken by the process and these show the stones in the road surface appearing as in relief, the shading of the ink giving a stereoscopic effect. The interpretation of the prints requires experience, and though a surface likely to be slippery is easily recognizable, the assessment of the relative slipperiness of various carpets from their texture prints is more difficult. A series of these prints exhibits the changing nature of a given road surface; the prints are very convenient both for comparison and for storage.

PLANKTON OF THE JAVA SEA*

AN interesting preliminary investigation into the plankton of the Java Sea by Dr. H. C. Delsman shows that the coastal waters contain much plant and animal life and that towards the central part larger animals abound. The two monsoons, the east monsoon about September and the west monsoon about February, have an important influence on the currents.

Two special cruises were made across the Java Sea, from Java to Borneo and from Borneo to Java, when a number of stations were made. The first cruise was in April at the end of the wet, west monsoon, the second in October at the end of the dry, east monsoon. Vertical hauls were also made from near the surface to near the bottom. A comparison of the catches shows that the volume of plankton is higher in October, even if it is taken into account that at this time the larger organisms predominated, such as salps, siphonophores and mysid and amphipod crustaceans. The diatom plankton was generally found along the coasts, whereas the zooplankton was greater farther out and in the middle of the Java Sea, where diatoms were practically absent but where, sometimes, there were masses of Trichodesmium. The coastal plankton is generally of a finer composition, and besides diatoms contains numbers of the smaller copepods. Copepods, both small and large, abound and are the main food of the plankton-eating fishes.

The largest and commonest copepod is *Undinula vulgaris*, reaching in the female 3 mm. in length. This species is absent near the coast at both seasons and is found at a maximum away from the coast but is not present in the middle of the Java Sea. In April it appears in greater numbers than in October. Fishes sometimes have their stomachs full of Undinula, which in value as fish food may be compared with *Calanus finmarchicus* in other seas. *Labidocera acuta*, another large copepod, apparently occurs under more oceanic conditions, occasionally replacing Undinula. The presence of the larger species of copepods at a certain distance from the coast is of much importance in connexion with the fisheries, and further studies in this direction should be of great value. This part of the sea is already a favourite place for the mayang fishers to put out their nets for carangids and clupeoids, presumably where their copepod food is most abundant.

It is found also that the structure of the gill rakers of the plankton-eating fishes, their shape and the nature of the eyes are different in the different regions. Those clupeoids which feed in the coastal waters on the fine plankton have finer and more numerous gill rakers; those feeding a certain distance from the coast, where the plankton is much coarser and probably swallowed more discriminately, have much coarser gill rakes, a more slender body and larger eyes, thus being more capable of darting after their prey. The higher the number of gill rakes the greater their length and the smaller the diameter of the eye.

It is to be hoped that these preliminary plankton studies will lead to others on a larger scale.

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* "Preliminary Plankton Investigations in the Java Sea". By Dr. H. C. Delsman. (*Treubia, bijdragen over Zoologie, Hydrobiologie en Oceanographie van den oost-indischen Archipel.* Deel 17. Aflevering 2. July 1939.)

SEVENTY YEARS AGO

NATURE, vol. 1, January 6, 1870

Plea for the Mathematician

PROF. J. J. SYLVESTER, F.R.S., in an article based on his presidential address at Exeter to the Mathematical and Physical Section of the British Association said: "Some people have been found to regard all mathematics, after the 47th proposition of Euclid, as a sort of morbid secretion, to be compared only with the pearl said to be generated in the diseased oyster, or, as I have heard it described, 'une excroissance maladive de l'esprit humain'. Others find its justification, its 'raison d'être', in its being either the torch-bearer leading the way, or the handmaiden holding up the train of Physical Science. . . . What is it to us, they say, if the three angles of a triangle are equal to two right angles, or if every even number is, or may be, the sum of two primes, or if every equation of an odd degree must have a real root ? How dull, stale, flat and unprofitable are such and such like announcements ! . . . But this is like judging of architecture from being shown some of the bricks and mortar, or even a quarried stone of a public building—or of a painting from the colours mixed on the palette, or of music by listening to the thin and screechy sounds produced by a bow passed haphazard over the strings of a violin."

Force of the Human Heart

IN an article on "The Labouring Force of the Human Heart", the Rev. Prof. Haughton, F.R.S., states that "its energy equals one-third of the total daily force of all the muscles of a strong man; it exceeds by one-third the labour of the muscles in a boat-race, estimated by equal weights of muscle, and it is twenty times the force of the muscles used in climbing, and eight times the force of the most powerful engine invented as yet by the art of man.

"No reflecting mind can avoid recognising in its perfection, and regarding with reverential awe, the Divine skill that has constructed it."

A SUCCESSFUL treatment for snake bite is recorded from the Rio Grande. Two horses were bitten by the same rattlesnake. A few hours afterwards the submaxillary, parotid, and all glands situated about the head and neck were greatly enlarged; from the nostrils and gums, a clear mucous discharge ran down; the eyes were glairy, with the pupils greatly dilated, and the coat was rough and staring. To each animal Dr. Bell gave half-a-pint of whisky, with a little water, and half an ounce of ammonia, while the wounds were fomented with a strong infusion of tobacco, and afterwards poulticed with chopped tobacco leaves. Both horses recovered.

"In furtherance of natural science work at Eton, an excellent telescope has been recently given to the school by the energy and liberality of some of the masters." Mr. H. G. Madan describes the instrument, a refractor of 5·9 in. clear aperture and 88 in. focus, made and erected by Messrs. Cooke and Sons, of York; it was equipped with a battery of eyepieces, of powers ranging from 30 to 400, and with a bifilar micrometer.

THE trigonometrical survey of England and Wales, on the scale of one inch to a mile, has been completed during the past week. It was commenced in the year 1791.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in the Electrical Engineering Department—S. C. Laws, Northampton Polytechnic, St. John Street, E.C.1 (January 8).

A Director of Studies for British Institute, Rome—The British Council, 3 Hanover Street, W.1 (quoting 'Italy') (January 13).

Civilian Surveyors of Works for the Military Engineer Services, India—The Military Department, India Office, S.W.1 (marked 'Surveyors Recruitment') (January 15).

Assistant Headmaster (later to become Headmaster) for the Mackay School, Valparaiso, Chile—The British Council. 3 Hanover Street, W.1 (quoting 'Chile') (January 20).

Temporary Forecasters, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B (Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Thirty-second Annual Report, 1938–39. Pp. 53. (Cardiff: National Museum of Wales.) [1312

North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1938–39. Pp. 32. (Aberdeen: North of Scotland College of Agriculture.) [1412

British Empire Cancer Campaign. Sixteenth Annual Report of the Grand Council. Edited by J. P. Lockhart-Mummery. Pp. x+370. (London: British Empire Cancer Campaign.) [1512

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 12: Further Studies on Transport in the Cotton Plant. vii. Simultaneous Changes in the Production and Distribution of Dry Matter under varying Potassium Supply. By E. Phillis and T. G. Mason. Pp. 889–900. (London: Empire Cotton Growing Corporation.) 2*s.* 6*d.* [1812

Ministry of Health. The Control of Puerperal Sepsis. (Memo. 226. Med.) Pp. 10. (London: H.M. Stationery Office.) 2*d.* net. [1912

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute. Report on the Work of the School for the Year 1938–39. Pp. xviii+98. (London: London School of Hygiene and Tropical Medicine.) [2112

Colonial Office. Higher Education in Malaya: Report of the Commission appointed by the Secretary of State for the Colonies, June 1939. (Colonial No. 173.) Pp. vii+151. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [2712

Other Countries

The Cooper Union for the Advancement of Science and Art. Eightieth Annual Report, for the Year ending June 30, 1939. Pp. 122. (New York: Cooper Union for the Advancement of Science and Art.) [712

Nigeria. Annual Report on the Forest Administration of Nigeria for the Year 1938. Pp. 14. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 1*s.* 6*d.* [1112

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse Nr. 42: Crossing West Spitsbergen from South to North. By Stanislaw Siedlecki. Pp. 14. Meddelelse Nr. 43: Some Pelecypods from Franz Josef Land, Victoriaøya and Hopen collected on the Norwegian Scientific Expedition 1930. By T. Soot-Ryen. Pp. 22+1 plate. Meddelelse Nr. 44: A Small Contribution to the Lichen Flora of the Eastern Svalbard Islands—Lichens collected by Olaf Hanssen in 1930. By B. Lynge. Pp. 12. Meddelelse Nr. 45: Recent Norwegian Expeditions to South-East Greenland. By Gunnar Horn. Pp. 10. Meddelelse Nr. 46: The Settlements and Huts of Svalbard. By Anders K. Orvin. Pp. 14. Skrifter om Svalbard og Ishavet, Nr. 76: Lichens from Jan Mayen collected on Norwegian Expeditions in 1929 and 1930. By B. Lynge. Pp. 56+2 plates. 4.50 kr. Skrifter om Svalbard og Ishavet, Nr. 77: Das Festungsprofil auf Spitzbergen, 5: Stratigraphie und Invertebraten-fauna der älteren Eotrias. Von Hans Frebold. Pp. 58+3 plates. 5.00 kr. (Oslo: Norges Svalbard- og Ishavs-undersøkelser.) [1112

Memoirs of the India Meteorological Department. Vol. 27, Part 2: Discussion of Results of Sounding Balloon Ascents at Madras in the Months of June to November during 1932–1935. By N. K. Sur and K. P. Ramakrishnan. Pp. 29–44+3 plates. (Delhi: Manager of Publications.) 14 annas; 1*s.* 3*d.* [1212

Publications of the Observatory of the University of Michigan. Vol. 8, No. 1: A Study of the Spectrum of VV Cephei. By Victor Goedicke. Pp. 36+4 plates. (Ann Arbor, Mich.: University of Michigan.). [1312

Proceedings of the United States National Museum. Vol. 87, No. 3073: Observations on the Birds of Northern Venezuela. By Alexander Wetmore. Pp. 173–260. (Washington, D.C.: Government Printing Office.) [1312

U.S. Department of Agriculture. Leaflet No. 189: Psocids, Annoying House Pests. By E. A. Back. Pp. 4. (Washington, D.C.: Government Printing Office.) 5 cents. [1312

Bulletin of the American Museum of Natural History. Vol. 76, Article 7: A Revision of the Typical Crab-Spiders (*Misumeninae*) of America North of Mexico. By W. J. Gertsch. Pp. 277–442. (New York: American Museum of Natural History.) [1312

Annales Bryologici: a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 12 (1939). Pp. vi+164. (Leiden: Chronica Botanica Co.; London: William Dawson and Sons, Ltd.) 6 guilders. [1312

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 3: High Educational Institutions in the Scheme of State Government. By John H. McNeely. Pp. v+108. 15 cents. Bulletin, 1939, No. 6: Education in Yugoslavia. By Severin K. Turosienski. Pp. vii+146. 25 cents. (Washington, D.C.: Government Printing Office.) [1812

Advisory Committee on Education. Staff Study No. 3: State Personnel Administration, with Special Reference to Departments of Education. By Katherine A. Frederic. Pp. xiv+270. (Washington, D.C.: Government Printing Office.) 35 cents. [1812

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. The Mining Laws of Canada: a Digest of Dominion and Provincial Laws affecting Mining. Compiled by Arthur Buisson. (No. 795.) Revised edition. Pp. vii+110. (Ottawa: King's Printer.) 25 cents. [1812

Colony of Mauritius: Department of Agriculture. Ninth Annual Report of the Sugarcane Research Station for the Year 1938. Pp. 66. 85 cents. Sugarcane Research Station, Bulletin No. 16: A Botanical and Agricultural Description of some Sugarcane Varieties raised by the Sugarcane Research Station, Mauritius. By Dr. H. Evans and G. C. Stevenson. Pp. v+10+5 plates. 45 cents. (Port Louis: Government Printer.) [1812

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 78, Nr. 5: The Godthaab Expedition 1938—A Theoretical Treatment of the Hydrographical Observation Material. By Alf B. Kiilerich. Pp. 150+14 plates. 8.50 kr. Bd. 105, Nr. 4: The Scoresby Sound Committee's Second East Greenland Expedition in 1932 to King Christian IX's Land—The British East Greenland Expedition 1935–36. Geological Investigations in East Greenland, Part 3: The Petrology of the Skaergaard Intrusion, Kangerdlugssuaq, East Greenland. By L. R. Wager and W. A. Deer. Pp. 352+27 plates. 20.00 kr. Bd. 119, Nr. 10: A Revised Index of the Insects of Grønland, containing a Supplement to the Insect List in Kai L. Henriksen and Will. Lundbeck: Grønlands Landarthropoder. (Medd. om Grønl., Bd. 22, 1918.) By Kai L. Henriksen. Pp. 112. 5.00 kr. Bd. 120: Poul og Niels Egede: Continuation af Hans Egedes Relationer fra Grønland samt Niels Egede: Beskrivelse over Grønland. Ved H. Ostermann. Pp. xi+380. 18.00 kr. Bd. 125, Nr. 1: An Annotated List of the Fishes collected on the Several Expeditions to Greenland, the Fox Basin Region, and the Coast of Labrador, by Capt. R. A. Bartlett, from 1925 to 1935. By Samuel F. Hildebrand. Pp. 12. 0.50 kr. Bd. 125, Nr. 2: The Greenland Variety of *Theromyzon garjaewi* (Livanow). By S. A. Boisen Bennike. Pp. 8. 0.35 kr. Bd. 125, Nr. 3: Contributions to the Glaciology of North-West Greenland. By J. W. Wright. Pp. 44+6 plates. 2.50 kr. Bd. 125, Nr. 4: i. Studies on the Embryology and Cytology of Saxifraga. By L. Harmsen. Pp. 16. 0.75 kr. Bd. 125, Nr. 5: Toxin in the Flesh of the Greenland Shark. (Communication from Upernavik and the University Zoophysical Laboratory at Copenhagen.) By Ove Bøje. Pp. 16. 0.75 kr. (København: C. A. Reitzels Forlag.) [1812

League of Nations: Advisory Committee on Social Questions. Enquiry into Measures of Rehabilitation of Prostitutes (Part 3 and Part 4): Methods of Rehabilitation of Adult Prostitutes, Conclusions and Recommendations. (Official No.: C. 83. M. 43. 1939. IV.) Pp. 157. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3*s.* 6*d.* [1812

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Ministry of Public Works, Egypt. Physical Department Paper No. 39: Report on the Measurement of the Quantity of Dust in the Atmosphere of Cotton Ginneries. By H. E. Hurst and P. A. Curry. Pp. 14. (Cairo: Government Press.) P.T. 5; 1*s.* [2012

Indian Forest Records (New Series). Entomology, Vol. 6, No. 1: New Indian Cerambycidæ. By J. C. M. Gardner. Pp. 14. (Delhi: Manager of Publications.) 6 annas; 7*d.* [2012

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U.S. Department of the Interior: Office of Education. Bulletin 1939, No. 10: The Graduate School in American Democracy. By Isaiah Bowman. Pp. ix+70. (Washington, D.C.: Government Printing Office.) 15 cents. [2112

League of Nations. Report on the Work of the League (continuation) July–mid-November 1939 (Official No.: A. 6 (a). 1939.) Pp. 62. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 1*s.* 6*d.* [2112

Anthropological Records. Vol. 1, No. 7: Culture Element Distributions, 11: Tribes Surveyed. By A. L. Kroeber. Pp. 435–440. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 25 cents; 1*s.* 6*d.* net. [2712

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UTILIZATION OF SCIENTIFIC MAN-POWER

THE concern which has recently found expression as to the position of science in the war effort of Great Britain, and the extent to which the services of scientific workers are being utilized, is evidence that the importance of this contribution is recognized far beyond the ranks of scientific workers themselves. The apparent tardiness with which the maximum contribution of science is being developed in the war-time effort of Great Britain has caused much questioning, and it is to be hoped that the activities of the newly appointed Advisory Council on Scientific Research and Technical Development will quickly overcome at least some of the obstacles which have appeared.

Political and Economic Planning (P E P) published a year ago an admirable broadsheet on "Man-Power Policy" in which four principles were laid down as essential and suggestions made for giving effect to them. It has now published a review of the present situation and its relation to economic policy under the title "Industrial Man-Power", in which the effect of expansion and contraction in industry in war-time is considered. The table showing the changes which have occurred in certain industries between 1923 and 1938 in Great Britain and Northern Ireland suggests that the great 'dilution' problem of the War of 1914–18 may be of much less importance to-day, since there now exists a range of metal trades already staffed for munitions, without the need to create them afresh.

This factor particularly affects the position of women, and it is accordingly unlikely, in view of the work already carried out under the Industrial Health Research Board and the National Institute of Industrial Psychology, that the grave social problems arising out of physical difficulties through the industrial employment of women will recur. The chief reason for alarm indeed appears to lie in the tendency of the Government to dispense with the Factories Act. The recent report of the Industrial Health Research Board recalls that its work was born of the experience of the War of 1914–18, but there are signs that scientific workers must bestir themselves if that entirely new attitude towards the study of working conditions and industrial welfare is to be preserved under the stress of the present war.

In industry as in civil defence, there is already evidence that the over-working of men and women has begun, and there are no signs of a consistent and well-understood policy in granting permission to work overtime. Equally it is important to conserve our limited resources of skilled labour by training, on a sufficient scale, fresh recruits for the less skilled operations. A scientific policy, which will keep alive the protective machinery and handle such problems before they become serious enough to damage health and efficiency, demands the co-operation of scientific workers as much as the prosecution of fresh research in these fields.

The difficulties experienced at the moment, however, are chiefly of a special and local character. There is some difficulty in spreading the available skilled workers evenly over the field, especially among the new munitions and aircraft factories. Social difficulties also attend the provision of the non-factory groups with work in munition factories. The dangers and opportunities in bringing many of these unorganized workers into official organizations are immense. Again, the labour requirements of several large industries, such as the textile groups, depend very much on policy, particularly export policy, and for this reason lack of a clear economic policy on the part of the Government is being held responsible for the rise in unemployment.

The P E P broadsheet forecasts a considerable scarcity of male labour in the coal-mining, shipbuilding and other heavy industries, rather than in the munitions industries, and stresses the fundamental changes in the whole structure of British society since the War of 1914-18 in relation to the industrial sources of man-power for the forces. A much greater proportion of the population is engaged in selling goods or performing personal services, and the entire non-factory working-class is larger in relation to the rest of the population. Of the non-factory groups, a much larger proportion are now employees rather than employers or workers on their own account. The distributive trades, personal services, and other non-factory trades and occupations are regarded as important sources of personnel for the fighting services and civil defence.

The change in the framework of labour relations involves, for a thorough study of the man-power problem, a survey of the changes in organization, and the broadsheet comments on the great "civil service" which has grown up in industry, represented by thousands of paid officials, hundreds of joint committees and slow-moving democratic machinery. Smooth adaptation of labour relations to war problems as they arise will depend on whether such constitutions reveal latent elasticity or become too brittle to bear the strain.

The value of the National Register as a basis for the scientific use of man-power does not require stressing here. The P E P broadsheet refers particularly to the Central Register of scientific, technical, professional or higher administrative workers, which is already being used by Government Departments and by firms engaged on work of national importance. Much unemployment still exists, however, among highly trained technical workers, particularly graduates in chemistry and other sciences, and even among professional workers such as architects, whose services would be expected to be in demand in numerous problems involved in civil defence and evacuation. A special section of the Central Register has been formed of those in this position, but the preservation of their abilities would seem to require a considerable extension of research programmes, even if such activity has no immediate connexion with war. So far as chemists are concerned, the establishment by the Chemical Society of an Advisory Research Council already provides a means for pooling suggestions for research and bringing them before those engaged in research in the universities and colleges.

Something more is required than improvements in placing methods. Formulation of a really adequate programme of work and its adoption by the Government could scarcely fail to secure the efficient and adequate use of the available scientific personnel and the disappearance of unemployment from the scientific register.

Certain suggestions were made by Sir William Bragg in his presidential address at the anniversary meeting of the Royal Society (see NATURE, Dec. 9, 1939, p. 953). Sir William Bragg suggested that a Ministry of Science would be too formal and rigid for immediate needs and that personal and elastic methods of using knowledge were the most successful. We might well be content to bring science as a whole into close relation with government as a whole by attaching a central authority of science to the central authority of the country. The immediate application of science in any department of national affairs should be made from within that department, not from without, and the real need is for means of ensuring that the Government is able to rely on and make use of the whole range of scientific knowledge.

The value of the Royal Society as a consultative body, so strongly urged by Sir William Bragg, will be endorsed by all scientific workers, most of whom will agree that the Government could well utilize these services much more widely and fully. It is, however, the evidence of a bureaucratic outlook, indicated by the interruption of important research as a result of evacuation or other exigencies and the neglect to provide alternative accommodation, that has occasioned misgivings in the minds of scientific workers. The Advisory Research Council of the Chemical Society appears to be the first organized attempt to mobilize the research resources of the country at the universities or elsewhere, and it may be hoped that the new Advisory Council will extend the process quickly and effectively.

In the meantime scientific workers might well follow the lead of Prof. J. D. Bernal, who at the recent annual council meeting of the Association of Scientific Workers alluded to a number of scientific problems which would appear to have been overlooked in the present situation. Suggestions for investigation should not be restricted to any one field. Prof. Bernal himself referred to the need for a scientific study of 'black-out' psychology and the effects of the 'black-out' on the temperament of the community. Similarly, problems of health and hygiene raised by evacuation and other changes await investigation.

Besides the suggestion and initiation of lines of investigation, the maximum development of our scientific effort in war demands an immense educational effort, and whatever central body is established will require to have under careful consideration the propaganda of science. Science cannot be used to the best advantage without the co-operation of the whole public. The stimulation of public interest in science is of vital importance to public efficiency and technical morale, and incidentally should provide a check on the bureaucratic tendencies which have been causing concern in some quarters.

The educational aspect is of importance from another point of view also. There is perhaps the danger that in the mobilization of scientific effort and resources in support of our cause, there may be further disposition to blame science for some of the evils of war. Propaganda of the type we have indicated should do more than prevent such misunderstanding. By promoting that full understanding and sympathy which are essential in the highest technical achievements, they should also prepare the way for science to make its full contribution, undisturbed by the demands of war, to the advancement of knowledge and the enrichment of human living.

VICTORIAN SOCIALISM

The New World Order

Whether it is Attainable, How it can be Attained, and What Sort of World a World at Peace will have to be. By H. G. Wells. Pp. 192. (London: Martin Secker and Warburg, Ltd., 1940.) 6*s*. net.

"FEW human beings," says Mr. Wells in his new book, "are able to change their primary ideas after the middle thirties. They get fixed in them and drive before them no more intelligently than animals before their innate impulses." Here he does himself a great injustice. We used to wonder what panacea he would discover next. He was sure to advocate it in a brilliant and stimulating manner.

But the time comes to all of us—it came to me long ago—when our minds stiffen, and we become, as a Frenchman unkindly said, the comedians of our early convictions. The hardships of his early life have permanently embittered Mr. Wells against the class in which his genius has placed him. He sees Red when he thinks of them, and exults in the destitution which he hopes awaits them.

So, since he is far too well-informed to be a Bolshevik, he has nailed his colours to that waterlogged derelict, Fabian collectivism. We have only to make a clean sweep of emulation, ambition, love of private ownership, patriotism and pugnacity, and we shall all be as happy, progressive and intelligent as a flock of sheep. That is always the way with Utopians. Abolish all the strongest passions and instincts of human nature, and a terminal state of blessedness, an earthly paradise, will be reached.

It is pathetic to look at the row of deserted idols which we used to worship in the last century: Liberalism, Democracy, Human Perfectibility, Socialism, Communism—there are few any more to do them reverence. Liberalism, which might sweep the suburbs with the Gladstonian creed of peace and retrenchment, is content to limp feebly after Labour, and has paid the penalty. Democracy is still a fetish in America, where it means anything, from an attribute of the Deity to a method of therapeutics, except what it really is, a not very successful experiment in government. "Uric acid," I read in a New York medical journal, "is tottering on its throne. The triumphs of Democracy are not confined to politics." Elsewhere it is merely accepted from inertia, or from fear of something worse. No institution has lost in prestige so much as the House of Commons. Who now reads the dreary debates, which are not expected to turn a single vote? (Democracy as a form of society—equality of consideration—is a different matter; some other name ought to be found for it.) As for human perfectibility, nobody any longer believes in a law of progress. The fact of progress in the past—for example, in the eighteenth and nineteenth centuries—cannot be denied. But in the future? We began with faith, we went on with hope; now there is nothing left but charity.

Socialism has never recovered from giving birth to its misbegotten brat Communism. There was such a thing as Social Democracy, though Socialism and Democracy are fundamentally incompatible. Nothing could be more ignominious than the total collapse of the Social Democrats in Italy and

Germany at the first impact of Fascism. The Bolsheviks found that the Social Democrats had not got the true milk of the word, and helped in their overthrow. Mussolini and Hitler were quick to observe the signs of the times.

Communism is also practically dead. It exists in the U.S.S.R. only for export; the Government of the Soviet Republic is pure Fascism or State capitalism. It would be difficult to name any prediction of Marx that has not been falsified by history; but the most significant of all his miscalculations was that after the success of the social revolution the State would "wither away". Instead of withering away, the State in Russia is omnipotent, the most brutal and searching tyranny that the world has ever known. Communism at home is now the creed of a few *enragés* and armchair doctrinaires, and of callow boys and girls at Oxford, Cambridge and the London School of Economics.

The total failure of the prophecy that the State under Soviet Socialism would wither away is important because it affects other kinds of socialism. The inevitable result of collectivism is to deprive the citizen of all liberty, and to put him at the mercy of a horde of ignorant, indolent and insolent Jacks-in-office, who take their orders from above. This is the crucial difference between State-socialism and democracy. The bureaucracy under socialism must take their orders from above. Mr. Wells wishes his citizens to be free to speak their minds; but your bureaucrat cannot stand criticism, and will know well enough how to gag it. Mr. Wells's Gestapo are to be "sturdy and assertive". There is no fear of their being anything else.

State-capitalism can make out a plausible case for itself. But apart from the difficulty of finding skilled administrators who are willing to give their best for a very small salary (in the U.S.S.R. differential salaries are as steeply graded as in England) in the absence of competition it is most unlikely that the infinitely complicated affairs of a great industrial community would be competently handled by State officials. Such experience as is available is very discouraging to the advocates of that favourite Fabian slogan, 'a planned economy'.

I entirely agree with Mr. Wells's detestation of the new idol which has dethroned the fetishes of the Victorians—frenzied nationalism. The deification of the State is indeed a monstrous and Satanic form of idolatry. It is at present the strongest force in the world, though it must be said to the credit of the democratic countries that it has made few converts in England, France or the United States. It unfortunately commands the allegiance of some of the best as well as the worst elements in the totalitarian countries, and is therefore the greatest danger that European civilization has ever had to meet. Nevertheless, to speak of the possible "extinction of mankind" (p. 18) is surely a violent exaggeration. The worst that can happen to Europe, if we persist in what are really civil wars, waged with greater fury than the old wars of religion, is that we may be plunged into another 'dark age', which we may hope would not last six hundred years, like the welter of barbarism which followed the downfall of Græco-Roman civilization. But America and the British Dominions would survive and hand down the torch. Count Keyserling, in his "Révolution Mondiale", unaccountably forgot the not unimportant part of the human race who speak English. For I do not think that even Great Britain will either cease to exist or relapse into savagery.

I also agree with the author about the ruinous folly of the present war; but perhaps at present the less said the better on that subject.

One protest I must make in conclusion. I am not supposed to be very fond of the Roman Catholic Church, but I deprecate Mr. Wells's very harsh words about that institution. Catholicism is certainly anti-revolutionary. With its unequalled experience of human nature, that Church knows that revolutions always lead to reactions, and achieve very little at a terrible cost of human suffering. But it preserves some valuable traditions which are in some danger of being lost, including a philosophy which is far superior to modern systems. I am specially distressed to read what Mr. Wells says about Spain. I cannot understand how any decent person can deny that the Nationalists were justified in taking arms against those devils in human shape, the Spanish Reds, who, fighting under the 'hammer and sickle', and under orders from Moscow, butchered three hundred thousand men and women, a hundred thousand in Madrid alone, in an attempt to extirpate whole classes of the population. It is difficult to forget what an American eye-witness saw in the town of Ronda, near Malaga. The Reds impaled on stakes all the male inhabitants who belonged to the middle class, and while they were dying in agony compelled them to watch their wives and daughters being first violated and then burnt alive. There are scores of similar horrors equally well authenticated.

Although Mr. Wells's Utopia seems to me utterly unrealizable, no one can read the book without admiration for his earnest longing for a new and better world. As Plato said of his Republic, the type of the perfect State is laid up in heaven, and we need not inquire too curiously whether it is likely to be realized on earth. The obstacles are human sin and folly, and we shall soon have sharp enough lessons to cure all but the incurable.

W. R. INGE.

TERRESTRIAL MAGNETISM AND ELECTRICITY

Physics of the Earth, 8:
Terrestrial Magnetism and Electricity
Edited by J. A. Fleming. Contributors: J. Bartels, L. V. Berkner, J. A. Fleming, O. H. Gish, H. D. Harradon, C. A. Heiland, E. O. Hulburt, H. F. Johnston, H. E. McComb, A. G. McNish, W. J. Rooney, B. F. J. Schonland, O. W. Torreson, L. Vegard. Pp. xii + 794. (New York and London: McGraw-Hill Book Company, Inc., 1939.) 52*s*. 6*d*.

INTEREST in geophysics is widespread in the United States of America to a degree paralleled nowhere else. This still young community, now in the first flush of vigorous scientific maturity, is from practical motives actively exploring the hidden riches of its land; it is also energetically studying the land, the sea, and the air, from purely intellectual motives. One consequence is that America possesses, in the American Geophysical Union, the largest geophysical society in the world; this Union publishes an extensive and many-sided annual report, but not, as yet, any general geophysical journal. America is, however, the home of the only existing journal devoted solely to terrestrial magnetism and electricity; and the only research institution which pursues all branches of this department of geophysics, from a world-wide point of view, is also American. It is therefore fitting that the volume under review, which is probably the largest general work ever published on the subject, should come to us from across the Atlantic. It will give a valuable stimulus and help to the study of the earth's magnetism and electricity, publications on which have hitherto been rather inaccessible to workers in other fields. The volume is one of a series of reports on geophysics prepared under the auspices of the U.S. National Research Council, with which the American Geophysical Union is associated.

The book is not a systematic treatise on its subject (and there remains a need for such a treatise); it is a collective work by fourteen authors, under the editorship of Dr. J. A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington —who himself, in the first chapter, on "The Earth's Magnetism and Magnetic Surveys", gives a general introduction to this, the larger of the two subjects with which the book deals. These two subjects are in fact not very intimately related to one another, and the four 'electrical' chapters—on "Atmospheric Electricity" (iv, Gish), "Instruments used in Observations of Atmospheric Electricity" (v, Torreson), "Earth-Currents" (vi, Rooney), and "Thunder-clouds, Shower-clouds and their Electrical Effects" (xii, Schonland)—might well have appeared as a separate volume; these chapters are excellently written in a systematic expository style, and almost constitute a treatise on terrestrial electricity, though of course this subject offers scope for a more detailed treatment. With their bibliography, these four chapters occupy about a quarter of the book.

No fewer than a hundred pages are devoted to a bibliographical chapter (xiii, Harradon); this is a valuable part of the book, because one of the difficulties in this, as in some other branches of geophysics, is that the original data and observations are for the most part not published in the scientific journals which have wide currency throughout the world; often they appear in separate publications or in observatory reports—the introductions or appendixes of which sometimes contain important discussions of the data, not to be found elsewhere. Moreover, owing to the border-line character of the subject (lying as it does between physics, astronomy, meteorology, geology and geography), together with the fact that there is only one journal expressly devoted to it, its current literature is scattered over an exceptionally wide collection of periodicals. Hence such a bibliography forms, as the editor states, "a most valuable research tool".

The remaining two thirds of the book includes two main groups of chapters, much more closely linked together than might appear at first sight. There are the more strictly magnetic chapters, including (with the first, already mentioned), "Magnetic Instruments" (ii, Johnston, Fleming and McComb), "Magnetic Prospecting" (iii, Heiland), "On Causes of the Earth's Magnetism and its Changes" (vii, McNish) and "Some Problems of Terrestrial Magnetism and Electricity" (viii, Bartels); and there are three chapters relating to the upper atmosphere, including one with that title (x, Hulburt), one on "Radio Exploration of the Earth's Outer Atmosphere" (ix, Berkner), and one on the "Aurora Polaris and the Upper Atmosphere" (xi, Vegard).

Workers on the many topics with which the book deals will recognize the authority of the writers who contribute the several chapters. With the exception of Chapter iii, the outlook of the book is more towards the purely scientific than the important practical aspects of the subject; it may be said to be directed to the initiation or enlightenment of physicists (and perhaps also astrophysicists) in one of the oldest of the modern sciences, which still confronts us with the mystery of Gilbert's great discovery that the earth is itself a magnet, and the but little less mysterious secular variation of the magnetic field. Apart from this, the exciting and complex problems of the subject are concerned mainly with the atmosphere; there is the semi-meteorological problem of the maintenance of the earth's negative surface charge, and the group of problems associated with the action of the sun upon the earth—for it is the sun which causes and controls the inconstant daily magnetic variation, the irregularly occurring magnetic storms and the associated auroras, and also the recently discovered group of terrestrial phenomena linked with eruptions in the solar chromosphere—radio fading and brief magnetic disturbances. The moon also, through the lunar tide which it produces in our atmosphere, plays a small but interesting part in causing the magnetic variations.

All these subjects are discussed in an interesting and authoritative way in this book, and if the voices are not always in unison, this is but a token of the need for more observation and more thought to illuminate dark questions. It is to be hoped and expected that many among the readers of this book will be led to take a share in making these "rough places plain".

S. CHAPMAN.

THE SOYA BEAN

Le soja et les industries du soja

Produits alimentaires, huile de soja, lécithine végétale, caséine végétale. Par A. Matagrin. Pp. x + 390. (Paris: Gauthier-Villars, 1939.) 60 francs.

IT is well known that the soya bean (*Glycine soja*) is one of the most valuable of cultivated crops, and this comprehensive account is of value, particularly at the present crisis, because of the numerous by-products that are obtainable from this particular plant. It is in fact one of the world's indispensable commodities.

The author records with considerable success the whole range from the cultivation of the bean to the manufacture of the latest form of by-product. In an account of the history and origin of the crop, it is pointed out that the home of the plant is eastern Asia, and in particular, Manchuria, Japan and China, from which regions, for many years, the main supply for the markets of the world was obtained. It is natural that other countries, with an eye to the valuable nature of the crop, should have endeavoured to establish it into their agricultural systems, and the most successful so far has been the United States. Here after years of trial and experiment, success has been attained in breeding types suitable to the climatic conditions, and the output of which now rivals in extent that of the Far East. In the detailed account that is given of the many attempts that have been made to establish the crop, it is noted that although the crop is stated to be adaptable and capable of growing from the equator to 50° S. and 60° N. respectively, yet success has, in the main, only been achieved on a grand scale in those countries possessing a temperate or subtropical climate.

In view of its great nutritive value, due to its high oil and protein content, there is little doubt that if the crop could be established in the tropics it would be of great value, not only because it is a valuable export crop which could be sold for cash and would, therefore, widen this field, which is so often held by cotton alone at present, but also on account of its food value. To the many who are now interested in the nutrition drive that is taking place in the British colonies its value is obvious; but it is not an easy crop to grow in the tropics. The number of varieties as indicated by the author is very great, but he brings out clearly that each variety has been evolved to meet particular types of soil and climatic conditions, and that each will usually only be found in a comparatively circumscribed area where it can enjoy these particular conditions.

The United States introduced numerous varieties and undertook prolonged selection before types suitable to American conditions were obtained. The trade demands a large round bean of a white or light colour, but unfortunately such experiments as have been made in the tropics indicate that the type of soya that grows best is one of a darker colour with a smaller and flatter bean. There is no doubt that much plant-breeding work will be needed before types really suited to the tropics can be evolved, although there is evidence that success will ultimately be obtained. Another difficulty is the short viability of the seed under tropical conditions. For this reason it is not always easy to obtain an even stand, with the result that disappointing crops are often reaped, although individual plants may often be excellent heavy bearers. The causes of this rapid loss in viability will, therefore, need to be studied and systems of storage, within the means of the peasant, evolved. Temperature is one contributing factor, as seed stored at about 60° F. keeps its viability well. It is probable that moisture content may be another factor as a natural corollary.

Another difficulty that will have to be faced is ignorance of the most attractive ways to prepare it for human consumption. Not the least valuable part of this book is the account given by the author of the different dishes that are prepared in various countries, and a campaign to educate the grower into the cooking of the bean will probably have to accompany any attempt to introduce it into his cropping system. The problem of inoculating the seed will also need to be faced, as it appears obvious that good crops cannot usually be obtained unless the right inoculum is present. This problem should not be difficult of solution, however, once a commencement has been made, as soil from an inoculated field can be used to extend the system.

Nearly half the book is devoted to accounts of the commercial products of the bean, particular attention being paid to the processes involved in the refining of the oil and its numerous uses, to the preparation of lecithin and the manufacture of vegetable casein, the demand for which has expanded greatly in recent years.

The volume is well arranged, but it is hoped that in a future edition an index will be added.

G. EVANS.

MYTHS AND MAGIC IN JAMAICA AND HAITI

Voodoo Gods

An Inquiry into Native Myths and Magic in Jamaica and Haiti. By Zora Hurston. Pp. x+290+24 plates. (London: J. M. Dent and Sons, Ltd., 1939.) 15s. net.

OBEAH in Jamaica and Voodoo in Haiti, as secret cults of the Negro, have both aroused considerable curiosity, mostly morbid. The literature relating to them is extensive, but more remarkable for its sensational statements than its ability to carry conviction as to its truth or accuracy of observation. It is, in fact, with a few notable exceptions, based on hearsay. Miss Hurston's knowledge of both cults has at least been acquired, to a great extent, at first hand; and her book is the work of a trained and experienced observer. As a member of the race she was qualified to take part in the ceremonial as an initiate, while as a pupil of Prof. Franz Boas she was able to grasp its significance as the manifestation of a form of religious belief, and view it with detachment.

Miss Hurston gives the two cults of Obeah and Voodoo their social setting in her accounts of the Negro community in Jamaica and of society and politics in the Black Republic of Haiti. The high lights of Haitian history are reached in revolution and massacre, more especially in the earlier years of the present century, leading up to occupation by the United States in 1915. The occupation lasted for nineteen years. Notwithstanding this story of bloodshed and corruption, the author sees in the recent growth of a young intelligentsia, which is making its mark in public life, the possibility of a future regeneration. There are indications of the growth of a national consciousness and of a decrease in the degree of cultural dependence on France.

In this movement towards cultural and national independence of white influence, it is thought by some, strangely enough, that Voodoo will play its part. This may seem surprising, in view of the fact that it has been usual to look upon Voodoo solely as an influence for evil, rather than as a form of spiritual belief, which could hold its own in the long run against one of the more highly organized religions, such as Christianity. This may be due to prejudice; and it has to be conceded that under the influence of the negro temperament, even Christianity itself may assume strange forms. At the same time the popular and darker view of Voodoo may not be entirely accurate.

Miss Hurston attributes much of the sensationalism which has become almost inseparable from accounts of Voodoo to a failure to understand its symbolism. Thus she maintains that the reverence accorded to the gods of the Negro in the guise of the Roman Catholic saints 'done over in black', the prominence of the snake in their cults, the erotic rites and the magical dances, and the like, are all parts of an elaborate system of symbolism, which has been, but should not be, taken at face value. Voodoo, in fact, is neither snake worship nor magic mixed up with fetichism, sacrifice and other of the more repulsive erotic and necrophilic practices of wizardry, but an organized body of pagan belief with an African pantheon.

The gods of the Haitian pantheon to a great extent are localized, and a spirit of great power in its own home may be unknown beyond a radius of fifty miles. Nevertheless some of the gods are reverenced generally; Damballa, for example, whose signature is the snake, and the goddess of love, whose position in relation to Voodoo as a fertility cult is indicated not only by the fact that she has no children, and is implacable to women, but also in that every man in Haiti is regarded as her husband. It is significant that two types of gods or spirits are recognized—the Rada or Arada, who are the good gods, to whom only pigeons and chickens are sacrificed, and the Petro, the more powerful and evil gods, who can, however, be made to do good things. To them are offered pigs, goats, sheep, cows and dogs, and even on occasion dead bodies from the tombs. The Rada are said to have been brought with the Negroes from Guinea or Dahomey; the Rada came from the Congo.

This brief mention of one feature only in Voodoo belief does less than justice to a remarkable record, which will repay close study by those who wish to understand the mentality which underlies what has been the most remarkable experiment in self-government of the black races, on their own initiative, of modern times.

HABITS AND HABITATS OF TROUT

Trout Streams

Conditions that Determine their Productivity and Suggestions for Stream and Lake Management. By Dr. Paul R. Needham. Pp. x + 233. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1938.) 3 dollars.

THIS book is an attempt to place in the hands of anglers, sportsmen, and aquatic biologists, trustworthy information relating to trout and streams in which they live.

The author is well qualified by years of experience to undertake such a work and has done it very well, not only using his own researches into stream problems but also that of many workers in his own country and in other lands where trout streams abound. The opening chapter deals largely with the various kinds of trout to be found in North America in both streams and lakes, dealing also with the habits of the different fish, followed by the chemical and physical conditions of trout streams in general and how such factors as temperature, transparency, oxygen content, and river bed play their part.

The importance of biological indicators as evidences of pollution as against that of chemical analysis is stressed—a line which is advocated in Great Britain. A very well illustrated chapter deals with trout stream animals which serve as food for trout, and should prove very useful to aquatic biologists, while it cannot fail to attract the angler with very little interest in stream organisms apart from fish. The line drawings and photographs are very clear and the tables show evidence of much work in collecting the data.

An interesting point to which attention is directed is the large numbers of land insects which are taken by trout at certain times of the year; the probable reason for this is well discussed. A very large number of stomach contents have been examined to obtain the information, and so far as streams in the central area of New York State go, the author points out the amounts of foods fall in the following percentages: caddis flies, two-winged insects and may flies, 66 per cent taken in the order stated, beetles fourth (6·6 per cent of total), spring tails, leaf hoppers, ants, bees and wasps furnish 3–6 per cent of the total, with other foods about 1 per cent, made up of crayfish, shrimps, grasshoppers, stone flies, true bugs and earthworms.

The distribution of the food in streams is dealt with under the heading of the physical conditions of the bed of the stream, stream flow and depth. The methods to be adopted in taking a census of the stream animals is described and is much on the lines adopted by workers in other countries. Stocking, propagation, and protection find a place in the book, followed by the management of trout waters gained by experience in many States.

A very useful appendix deals with the numbers and sizes of fish it is wise to introduce into streams where restocking is done, taking into account size of stream and available natural foods. Outlines are given of stream surveys and how the information should be recorded to be of use for comparison with later surveys or with those of other rivers.

There is a very extensive bibliography, which should prove very useful to those seeking fuller information on the points dealt with. The book is very well illustrated with photographs of weir fishing pools and the like, making it very attractive to the non-technical reader as well as the scientific investigator. It also gives an insight into the extent of the investigations undertaken by workers across the sea, and being written by one who, in addition to being a scientific investigator is also an angler, links up the two sides of the questions that arise.

W. RUSHTON.

CHEMISTRY FOR INTERMEDIATE EXAMINATIONS

(1) General and Inorganic Chemistry
By Dr. P. J. Durrant. Pp. x + 547. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 8*s*.

(2) A College Course of Inorganic Chemistry
By Prof. J. R. Partington. Pp. x + 658. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*.

(3) Intermediate Chemistry, Inorganic and Physical
By Dr. Frederick Prescott. Pp. viii + 828. (London: University Tutorial Press, Ltd., 1939.) 12*s*. 6*d*.

THE number of chemistry text-books is becoming greater every year, and because of their number, the final selection of a suitable book is becoming increasingly difficult. During the last few years, the needs of those taking intermediate science examinations and university entrance scholarships have received special attention, and here are three new books catering for their requirements.

(1) Of the people who write text-books, the one who obtains the deepest insight into the student mind is not the teacher (who may, in fact, be very ignorant of its contents) but the examiner. He, more than any other, is familiar with the facts which are absorbed, and the heresies which persist. Dr. P. J. Durrant is not without experience as an examiner, consequently something exceptional was to be expected, and expectation has not been disappointed. The book he has written is an admirable one, and the reviewer can fully endorse the report of the publishers' reader that "the book has originality and vitality of presentation and gives a balanced and cultural appraisal of a difficult subject". Not only is this so, but the type, headings, spacing and arrangement of the text are excellent and make an immediate appeal to the eye.

The outlook is modern, Bohr's theory of atomic structure and the electronic theory of valency are introduced at an early stage, and are used as a basis for the explanation of chemical theory. The scope of the book is not limited to the syllabus of any particular examination, and it would take the student through his first year at the university. The less common elements are omitted, and only compounds of definite technical or theoretical interest are included. The only important omission is a chapter on radioactivity, which might, with advantage, have been included. Errors are extremely rare: the quantum shells (p. 116) are presumably those of uranium, where the *P* shell contains 12 not 13 electrons, and *catronic* (p. 297) is an obvious misprint.

(2) Prof. J. R. Partington's "Text-Book of Inorganic Chemistry" first appeared in 1921 and is now in its fifth edition. Successive editions have grown in size with the passing of time, until it is now too comprehensive for 'inter.-science' students. His "College Course of Inorganic Chemistry" is intended to meet the needs of the latter, especially those rather older students who are beginners, as well as younger pupils.

Although the plan and method of the "Text-Book" have naturally served as a foundation for the smaller work, much of the text has been rewritten and rearranged. Nevertheless, the familiar and successful "Partington" method is obvious throughout. The historical approach has been retained, special attention being given to the physical chemistry required at this stage, and although designed only as an intermediate text-book, it contains a very considerable amount of information and details of industrial processes.

Opinions differ as to how soon the student should begin to use and appreciate the significance of electronic formulæ. The modern tendency is to introduce them early and even to abandon the classical 'structural formulæ' entirely. The fact that here the former are sparingly used, and the latter largely retained, gives the book a somewhat old-fashioned appearance which might not entirely satisfy a modern teacher. This is the only criticism of the book, which well maintains the high "Partington" standard.

(3) Dr. F. Prescott's "Intermediate Chemistry" is described as "an entirely new book, a well-planned course of Inorganic and Physical Chemistry, based on modern ideas associated with the inter-related domains of Physics and Chemistry". The plan and balance of the book are good, but the contents are of very uneven quality, and the proof-reading has been entirely inadequate. A perusal of the book revealed twenty-one incorrect equations (and there may be more, for a systematic search was not made), many incorrect formulæ, and small errors in the text. All these mistakes are obvious and would be detected by the dullest student.

The section on the structure of the atomic nucleus and the occurrence of isotopes (pp. 252–4) contains the following sequence of statements: (*a*) the nucleus consists of protons, or particles of positive electricity, and, in most cases, electrons, the protons always being in excess; (*b*) the atomic number corresponds to the net positive charge on the nucleus; (*c*) the mass number (atomic weight) is equal to the number of protons in the nucleus; (*d*) the difference between the mass number and the atomic number is attributed to neutrons in the nucleus; (*e*) neutrons are particles with a mass nearly that of a proton; (*f*) the neutrons, being of negligible mass, may be disregarded. The table (p. 253) which gives the atomic structure of a number of selected elements does not mention the neutron, which, considering its (apparently) uncertain properties, is perhaps just as well.

'Partington' and 'Durrant' are widely contrasting books, complementary rather than competitive. Partington is historical, somewhat discursive, and (at least once) reminiscent (p. 433). Durrant is non-historical, logical, modern, and provides much tabulated information, of which Partington (p. vii) disapproves. The teacher may choose according to his tastes. J. N. SUGDEN.

BIOGEOGRAPHY IN THE U.S.S.R.

(1) Zoogeography

By I. I. Puzanov. Pp. 360 + 32. (Moscow: State Publication Office of the Commissariat for Education, 1938.) 7·80 roubles.

(2) Zoogeography of the Ukrainian Socialist Soviet Republic

By M. Sharleman. Pp. 234 +1. (Kiev: Ukrainian Academy of Sciences, 1937.) 6·60 roubles.

(3) Vegetation of the World

(Plant Geography, vol. 3.) By A. P. Il'inskij. Pp. 458. (Botanical Institute of the Academy of Sciences, Moscow-Leningrad, 1937.) 10 roubles.

ALTHOUGH the three books referred to above by no means exhaust the most important biogeographical publications that have appeared in the Soviet Union during the last few years, they deserve special notice for various reasons.

(1) Prof. Puzanov's book on zoogeography is of interest as an attempt to produce a text-book in this subject, which is still taught in too few universities, one of the reasons being the lack of suitable books for students. A brief introduction dealing with the aims and methods of zoogeography and giving a concise history of the science is followed by two general parts. The first presents a lucid discussion of the ecological principles of zoogeography; the second deals with dynamics of faunas from a geological aspect. This difficult problem is dealt with in a very clear manner, without superfluous detail, while avoiding undue simplification. The third, and the main, part of the book is devoted to regional zoogeography, that is, to descriptions of the faunas of various regions. These descriptions are based mostly on vertebrate animals, but whenever possible some data on insects, etc., are also given. A feature of the book is the abundance of very well-executed (but poorly reproduced) original illustrations of numerous animals mentioned in the text. There are even three plates in colour, but their standard is low.

On the whole, the book undoubtedly represents a very successful approach to a university text-book of zoogeography, which is as yet lacking in any language, in spite of a seriously felt need for one.

(2) Sharleman's book on the zoogeography of the Ukraine is an original treatise on the regional distribution of vertebrates of that country in connexion with their ecology and geological history. The book is written in the Ukrainian language, but Russian and English summaries are appended, while a complete list of species showing their distribution by districts, and a very full bibliography should make it very valuable for workers on the Palæarctic fauna.

(3) The book on the vegetation of the world by Il'inskij is published as the third (and concluding, but first published) volume of a series, the other two of which deal with plant geography and plant ecology respectively. The general part of the book is very brief—because the two other volumes just referred to should supply the introductory knowledge to the present one, which contains descriptions of types of vegetation by continents and natural regions. Most of the descriptions are clear, concise, based on up-to-date information and illustrated by well-reproduced photographs. All this goes to make a good text-book that should be very useful, particularly to geography students.

Indeed, it can be said that geography departments in Soviet universities are particularly fortunate in having modern text-books in both branches of biogeography, by Puzanov on animals and by Il'inskij on vegetation. The appearance of similar text-books in English would go a long way towards introducing biogeography into British and American universities, where this science is suffering from undeserved neglect. B. P. UVAROV.

MARGARINE

By Prof. J. C. Drummond,

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Early History

IT is unlike the French to be unmindful of a son of their country who has rendered notable service in so important a matter as food, yet I am not aware that the achievement of Mège-Mouries is commemorated in France by a public monument or inscription or even by a street name. Equally surprising is the scanty information supplied by biographical works of reference about that most ingenious inventor. Perhaps we can attribute this to the lack of sympathy one would expect from a nation which appreciates above all other things good food and good cooks, towards one who hoped to pass off the greasy and rather unpalatable products of his laboratory as butter. Whatever the reason for such neglect, the fact remains that the French might well be proud to claim the inventor who made possible one of the greatest food industries of our time.

It is often erroneously believed that Mège-Mouries set out to concoct a substitute for butter. It is true that he was stimulated by the desire of the Victualling Department of the French Navy to find such a substitute ; but he himself was more ambitious. He attempted to produce butter itself, and that by a series of laboratory treatments that he thought would reproduce exactly the changes by which he believed body fat to be converted into milk fat in the animal body. His laborious process, in which beef fat was digested at blood heat, first with macerated sheep's stomach and then with chopped cow's udder and milk, actually gave him nothing more unusual than the softer portion of the original fat, carrying, presumably, some traces of a milky flavour. Nevertheless, in the early days he was quite satisfied that he had made butter. Others, less optimistic, were content to believe that he had solved the problem of preparing an edible substitute for butter, and for this achievement he was honoured in 1870 by Napoleon III.

Had it not been for the Franco-Prussian War, it is probable that France would have led the world in the technical development of the new process. As it happened, the opportunity was seized in the United States and in Holland. In a remarkably short time factories were springing up in these countries for the manufacture of what was then called 'butterine'. It was soon found that Mège-Mouries's complicated digestion was quite unnecessary, and that all it was necessary to do was to mix as thoroughly as possible with skimmed milk, preferably slightly sour, a fat of the appropriate melting point. On separating the fat again it was found to have acquired a buttery taste. It could then be 'worked', salted and coloured to taste.

Manufacture in Great Britain lagged far behind in the seventies. So far as can be judged from the contemporary press, the home-produced material was, moreover, of very inferior quality. Most of it was made in small, dirty, 'back-street' premises under highly insanitary conditions. To a large extent it was knowledge of these facts that gave 'butterine' so bad a reputation at that time. The English public was ready to believe any fantastic yarn about the doubtful nature of the fats used by the manufacturers, and they also suspected, often with more reason, that a good deal of the despised stuff was employed as an adulterant for butter. The passing of the Margarine Act in 1887 did something to allay uneasiness ; nevertheless, the reputation of the new food remained an unsavoury one for a good many years.

Improvements in Manufacture

Then in 1889, Otto Monsted opened the first up-to-date factory in Great Britain. The pioneers were faced with a truly formidable task. Prejudice against margarine was at that time shared by rich and poor alike, and opposition from certain other trades, particularly the dairy industry, was vigorous and none too scrupulous. The product Monsted turned out was made from that fraction of beef fat which is known as 'oleo' or 'premier jus'. It was, in fact, a highly digestible fat possessing a calorific value equivalent to that of ordinary butter and, what was of great importance although unknown at the time, its vitamin A, and probably also its vitamin D, content was by no means negligible. It is probable that its nutritive value was not far below that of ordinary 'average' butter ; but it is difficult to make a proper estimate because it is a curious fact that an extensive modern literature on the vitamin contents of foods does not give us any information as to the A and D value of the common edible body fats such as those of beef or mutton.

By comparison with our modern margarines these primitive materials were undoubtedly very crude. They were inclined to be unpleasantly greasy, to stick to the knife, and to spread in a manner unattractive to those used to butter. Moreover, they often had a 'fatty' taste and smell which many people disliked.

No problem has given the margarine manufacturers more trouble than that of producing a texture resembling that of dairy butter. The introduction about 1890 into margarine manufacture of vegetable oils suitable for blending with 'oleo' helped them to some extent; but it was not until some years of the new century had passed that their fortunes turned. By this time the small producer was dropping out of the picture and with him many brands of dubious quality which had served to keep alive an unenviable reputation. To an ever-increasing extent manufacture was passing into the hands of large commercial organizations guided by directorates not only anxious to provide the consumer with an article of high quality, but also prepared to spend very large sums of money on scientific and technical research to that end. One by one the problems were attacked and solved. Care in the selection of oils for blending; improved methods of emulsifying the mixture with pretreated separated milk; controlled crystallization of the final product to get the right 'grain'; special precautions to be taken in 'working' a mixture differing in many subtle characteristics from butter; such knowledge, gained by patient and costly research, brought about remarkable improvements in respect of that almost indefinable but all-important character of texture. Chemists, biochemists and bacteriologists collaborated to select the appropriate bacterial flora which would produce in the separated milk just the right blend of substances necessary to impart to the margarine that elusive 'butter flavour'. Others ingeniously prepared chemical flavouring substances to serve the same end.

Another important milestone was the introduction of 'hardened' vegetable and animal fats.

Such have been the labours that have gone to produce the high quality of the popular butter substitute we know to-day.

VITAMIN REINFORCEMENTS

The period of the War of 1914–18 is very important in the history of margarine. At that time most authorities on dietetics regarded margarine as a reasonably good substitute for butter, because it was well digested and for all practical purposes provided the same heat-producing power. It was one of the cheaper forms of energy.

During the latter part of the War, however, the importance of the fat-soluble vitamins, discovered a few years before, gradually came to be recognized. The nutritive worth of edible fats could no longer be assessed solely in terms of digestibility and energy equivalents. It was necessary to ascertain whether they would also provide the newly discovered constituents. Butter was found to contain them. On the other hand, most of the vegetable oils and fats then being used more and more extensively in margarine manufacture, as well as the hardened fats which had come into use soon after 1910, were found to be defective in this respect. Following up the obvious line these observations indicated, the late Prof. W. D. Halliburton and I examined a number of typical margarines and found that their nutritive value for the growing animal was determined by the vitamin contents of the constituent oils and fats. Margarines prepared almost solely from beef 'oleo' appeared to be as nutritive as butter, whereas the vegetable oil margarines, in spite of being excellently assimilated, did not supply the fat-soluble 'growth-promoting' factors needed by the young animal.

These observations made little impression on the margarine industry at the time. Such reaction as there was consisted of frank scepticism. Some people challenged the conclusion that vegetable oil margarines were devoid of vitamins by directing attention to the fact that milk, which in a vague sort of way was thought to be one of the richest sources of the accessory factors, was employed in the manufacture of the products. Others refused to acknowledge that experiments on rats could have any bearing on human nutrition. Others, again, argued that such small differences in composition of a single article of diet could scarcely be of any practical significance. Nearly ten years passed before serious attention was given to the matter. Then, at last, the margarine manufacturers moved. Many of the earlier attempts to raise the nutritive value of their products by the addition of vitamin preparations were failures. For the most part they were attempting to employ materials and concentrates prepared from cod liver oil. It was not a difficult matter to add sufficient of such supplements to bring the vitamin value of margarine up to that of an 'average' butter; but it was found that such additions almost invariably ruined the flavour and palatability besides materially increasing the cost.

The first real progress was made after the discovery of the method for preparing pure crystalline vitamin D_2 from ergosterol. It then became possible to raise the antirachitic value of a margarine at a very slight cost without affecting edibility in the slightest. To confer on margarine a vitamin D activity of 30 units per ounce, it was necessary to add only one ounce of vitamin D_2 (calciferol) to 120 tons of margarine. What was next required was a cheap and effective source of vitamin A. It was found in one of the by-products of the whaling industry operating in Antarctic waters. Like other mammals, the whale stores considerable amounts of vitamin A group in its liver, though on the other hand it has curiously small reserves of D. The development of the factory-ship organization in the far southern waters made available large quantities of whale liver fat. It had the advantage not only of being valuable as a source of A but also of yielding material which could be employed without impairing the flavour of the finished margarine. By employing this supplement and at the same time adding artificially prepared vitamin D, the production of a satisfactory 'vitaminized' margarine for the ordinary market was achieved. Brands prepared with such additions first came on the market about six years ago. Not unexpectedly, they aroused a good deal of hostility from the butter industry, and there have been sharp controversies between the rival interests. With the many and widely differing aspects of these controversies we cannot be concerned here. Suffice it to say that in one country at least a rather bitter trade war has been terminated by a government-inspired 'gentleman's agreement' to 'live and let live'.

More recently, success has rewarded efforts to prepare from fish liver oils concentrates of A and D suitable for adding to margarine. They are prepared from liver oils of very high initial potency. So small an addition is required that the palatability of the final product is unaffected, and, what is so important, the cost is almost negligible.

MARGARINE IN THE NATION'S DIET

It is very important, particularly at a time like the present, to try to get such a valuable foodstuff as margarine into proper perspective with the diet of the nation. In 1938, a year in which butter was, generally speaking, cheap, the weighted average consumption per head of the population of Great Britain was 7·6 oz. a week, while the corresponding figure for margarine was 2·3 oz. Even the people classified in the poorest category of the population purchased, on an average, 4·5 oz. of butter per head per week.

If we take, as a peace-time basis for our argument, 10 oz. per week as a rough and ready estimate of the consumption of butter and margarine by the people of Great Britain in 1938, and if we also assume that the whole supply had the same vitamin content as an 'average' butter, we find a weekly intake of, approximately, 5,500 units of A and 150 units of D. Had the whole ten ounces been an 'average' vitamin-reinforced margarine, the intake of A would have been somewhat less, whereas the D supply might have been nearly twice as large. In either event, these quantities approximate more closely to the requirements of the individual for one day than to those for a whole week.

In other words, the 'average' individual is more dependent on milk, eggs, green vegetables, etc., than on butter and 'vitaminized' margarine for vitamins A and D.

It is very important to remember, therefore, that the consumption of these alternative sources of fat-soluble vitamins is pitifully small among the poorer sections of the community. Under such conditions the question of the vitamin content of margarine assumes greater importance.

A consumption of 4·5 oz. of butter weekly—which is slightly more than the official ration—together with the balance of 5·5 oz.—assuming once again a total intake of 10 oz.—in the form of a 'non-vitaminized' margarine, would provide a mere 2,500 units of A and 70 of D. That is scarcely a conspicuous contribution to what the body requires. Such figures signify that a good proportion of the poorer people were receiving insufficient of these two vitamins under the relatively good conditions prevailing in 1938. There is evidence from other sources that this was so.

The deficiency was, of course, very much more serious at the end of the War of 1914–18, when rationing restricted weekly supplies to 1 oz. of butter and 4 oz. of margarine, none of the latter being 'vitaminized'. From these foods the individual could count on little more than 550 units of A and 15 units of D in a week—about one tenth of an adult's daily needs!

With rationing of butter in force, and having in mind the limited purchasing power of the poorer sections of the community, the desirability of enriching all margarines with vitamins A and D supplements must appear obvious.

At the present time a large proportion of the margarine sold over retail counters is so enriched. Unfortunately, there does not appear to be uniformity between the various brands, although for the purpose of general estimates such as have been made in this article, the content of an 'average' vitaminized product can be taken as 450 units of A and 30 units of D per ounce. A weekly supplement to the butter ration of 6 oz. of reinforced margarine could be regarded, therefore, as adding some 2,700 units of A and 180 units of D to the diet. It is certainly nothing to boast about; but one must remember how valuable is every unit where poverty diets well below the marginal nutritional level are concerned.

It will not be possible to plead ignorance this time if vitamin deficiency is allowed to be responsible for a decline in general health such as occurred during the years of 1914–18.

TOWN'S REFUSE AS A SOURCE OF SOIL ORGANIC MATTER

BY DR. E. H. TRIPP

ALTHOUGH animal and vegetable wastes have been used as manure for untold ages, and their good effect on soil fertility has never been in doubt, chemists and microbiologists would be the first to confess that there are many gaps in our knowledge of their modes of action. To take farmyard manure—still without a rival—we know the value of the plant foods it contains, and its remarkable power, after decomposition, of promoting and conserving the granular structure of the top soil, thereby making it porous to air, absorptive and retentive of moisture. How this physical effect is brought about is still largely a matter of hypothesis ; and generally speaking, we know nothing of the sequence of changes that follow the incorporation of farmyard manure with the top soil.

The solution of such questions would help in determining beforehand the possibly beneficial action of many other organic substances that are or might be available to eke out our diminishing supplies of farmyard and stable manures. At the present time, when it is planned to convert millions of acres of inferior grassland into arable, the provision of additional supplies of humus-forming material becomes exceptionally important.

A potential source of supply of organic manure is the refuse of cities and large towns that is now carted away and dumped on to waste land or into the sea. The composition and production of such refuse have, *inter alia*, been investigated by a sub-committee of the Institute of Public Cleansing, and reported upon by H. Edridge (1937). Samples of the refuse collected from 485,894 houses, with 2·082 million people, contained an average of 13·23 per cent of vegetable and putrescible matter, corresponding to more than one million tons of such matter contained in the estimated total of 8·3 million tons for the entire annual output of the United Kingdom. The percentage of organic matter in the refuse varied considerably with the class of dwelling ; that from artisans was 9·96, from the middle class 15·33, and from the 'better' class 16·62. Paper averaged 14 29 per cent, and rags 1·89 per cent.

The question arises, therefore, whether such refuse can be used as an organic manure, either directly or after processing. As criteria of suitability the main considerations are : contents of nitrogen, cellulose and lignin, and rate of decomposition in the soil. Although little work has been done in these directions, a few practical men have been forestalling scientific inquiry. The Corporation of St. Albans, Herts, is producing material that is reported to have given good results on neighbouring farm land, and the Royal Borough of Kensington is disposing of all its refuse to a private company that is converting it into an organic manure in a plant designed to treat 250 tons a day, situated at Wood Lane, London, W. A similar plant is to be in operation at Harrow early in 1940. The process is simple : grosser solids like metal containers, glass, and paper are picked out by hand on moving belts ; the material is crushed, sprayed with a culture of nitrogen-fixing bacteria, and then allowed to ferment, aerobically and anaerobically, for sixteen days in large chambers. The product has little odour, and is a coarse brown powder containing about 30 per cent of organic matter (with about 1 per cent of nitrogen), 40 per cent of inorganic solids, and 30 per cent of moisture.

Large-scale replicated experiments to determine its manurial value were undertaken by the Rothamsted Experimental Station on a wide variety of soils at Rothamsted on kale, Woburn on sugar-beet, Tunstall (Suffolk) and Siddlesham (Sussex) on potatoes, and at High Halstow (Kent) on mangolds. The treated town's refuse (termed 'Hyganic') was compared with farmyard manure, rape-dust, and sulphate of ammonia in single and double doses. The chief interest lies in the comparison with farmyard manure at Rothamsted where, on an equal nitrogen basis, 'Hyganic' proved superior three times out of four ; and at Woburn where, although the differences in terms of sugar per acre were not statistically significant, there was an advantage of 3 cwt. per acre of sugar in favour of 'Hyganic' when double dressings (1·6 cwt. nitrogen per acre) were applied. The value of the nitrogen in the manure was found to be nearly equal to one half that in sulphate of ammonia.

The results apply to the year of application only (residual effects were not examined), but they show that the organic matter in the town's refuse decomposes quickly, rendering the contained nitrogen readily available. The relatively rapid decomposition in the soil may well be associated with the beneficial effect on soil texture, which has been observed by market-gardeners and others, thus supporting Geltzer's generalization that the rate of decomposition of organic matter in a soil is directly related to the stability of the larger soil-aggregates that determine a good tilth.

MAGNETISM AND THE STRUCTURE OF MATTER*

By DR. KATHLEEN LONSDALE
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THE first attempts at an explanation of magnetic phenomena were mainly concerned with the problem of action at a distance, but later the centre of interest shifted to the mechanism within the magnetized body which came into action under the influence of the external field. After the discovery by Oersted of the magnetic effect of an electric current, Ampère suggested in 1825 that a hypothesis of molecular currents might explain induced and permanent magnetization. At the time, only ferromagnetic phenomena were known, but the design of powerful electromagnets enabled Faraday to make the fundamental discovery that all matter is affected to a greater or less degree in a magnetic field. There are two broad types of behaviour: diamagnetic substances tend to move from the stronger to the weaker part of a non-uniform field and to set their longest dimension at right angles to the lines of force; paramagnetic substances move from the weaker to the stronger part of a field and set their length along the lines of force. Faraday showed that the resultant flux (lines of force per square centimetre) within a diamagnetic body must be less, while the flux within a paramagnetic body must be greater, than that in the external field. That means that the induced magnetization within a diamagnetic body opposes the inducing field, while that within a paramagnetic body reinforces the field.

Weber suggested in 1854 that if electric currents could exist within molecules, then substances might be divided into two classes according as to whether their molecules had a resultant magnetic moment due to circulating currents or not. Only the former could show paramagnetism. This is the basis of the Langevin theory. The atom is now known to be built up of particles of a certain mass and charge, the velocity and distribution of which can be varied under certain conditions. Magnetism is a property of these ultimate particles, because a moving charged particle is equivalent to a current in a circuit and therefore possesses a magnetic moment.

DIAMAGNETISM

Diamagnetism is due to induced currents within the atom, these induced currents taking the form of a modification of the existing motion of the electrons. The orbits precess about the field direction, and this extra electronic motion gives rise to a magnetic moment the value of which depends on the field strength, the electronic mass and charge, and the projected areas of the electronic orbits. The gram atomic susceptibility (ratio of the intensity of magnetization per gram atom to the inducing field) is entirely governed therefore by the distribution of electron density in the atom. All atoms show diamagnetism, but unless the resultant angular momentum of the atom is zero in the absence of a field, paramagnetism or ferromagnetism will also be present and the diamagnetism is relatively unimportant.

The susceptibilities of the inert gases have been measured and compared with those calculated from spectroscopic knowledge of the electron density distribution. Other atoms or groups of atoms may attain zero resultant angular momentum in three principal ways. In *ionic compounds* the component atoms may give or accept electrons, so that the external shells of each are completed. This occurs, for example, in the alkali halides. The susceptibilities of such polar compounds are additive, but when the compounds are dissolved in water, only dilute solutions show additivity. In concentrated solutions the ions not only depolymerize the water, but also form hydrates and other complexes. The electronic structure both of the ions and of the water molecules is deformed, with a consequent change of susceptibility. The structures of light and heavy water and of water of crystallization are also being studied by measurements of susceptibility.

In *homopolar compounds* the atoms share electrons, thus completing their electron shells or pairing off their odd electron spins. The diatomic molecules H_2, Cl_2, Br_2, etc., are diamagnetic because the electron spin of one atom is antiparallel to that of the other. In O_2, however, the electron spins are parallel, giving rise to a strong paramagnetism. Nearly all organic compounds are diamagnetic, and Pascal has shown that their molecular susceptibilities obey an additive rule $\chi_M = \Sigma\chi_A + \lambda$, where λ is a factor which makes allowance for the different kinds of valency bonds. This rule can be used for the determination of chemical constitution in doubtful cases, and for the study of polymerization. Complex compounds are frequently diamagnetic because the effective atomic number of the complex group is equal to that of an inert gas, but this alone is not a sufficient criterion. The state of the electrons taking part in the formation of chemical bonds;

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* Substance of a special course of lectures for students, given at the Royal Institution on November 29, December 6 and 13, 1939.

is important. Measurements of susceptibility are now being used to investigate the constituents of natural products, including blood.

In *metallic compounds* the valency electrons become free electrons having a small resultant paramagnetism, while the positive metallic ions will be diamagnetic if their outer shell is closed. Thus many metals are weakly paramagnetic or diamagnetic. In some semi-metals such as bismuth, antimony and graphitic carbon, the binding electrons are not really free; their energy states bear a definite relation to the crystal structure and this results in high diamagnetism and large anisotropy, both of which disappear on melting or can be radically changed by the solution in the solid of small quantities of other elements.

Normally, diamagnetism is independent of temperature and of change of state, but a metal which becomes superconducting at very low temperatures always becomes also strongly diamagnetic. Except for a very small surface region, no flux can penetrate an ideal superconductor, the permeability being zero throughout the interior of the metal and changing from zero to unity in a region of about 1000 A. width below the surface. The supercurrent, which exists only in this surface region, is according to the theory of London a stationary current dependent upon the presence of a magnetic field, similar to that in a large diamagnetic atom. In wires, films or particles of dimensions comparable with 1000 A., the susceptibility is only a fraction of that of the bulk superconductor. Slater has suggested a molecular model for the theory of London on the basis of semi-bound electrons with very large wave-functions, and explains the 'threshold field' as that value at which the Larmor precession energy becomes comparable with the 'atomic' energy.

In aromatic organic compounds there are electrons which occupy large plane orbits, and this results in a large molecular anisotropy. From the principal susceptibilities of single crystals of such substances, it is sometimes possible to determine the orientations of the molecules, or if the crystal structure is known to deduce the electron distribution in the molecule.

PARAMAGNETISM AND FERROMAGNETISM

Any atom or ion will be paramagnetic that does not succeed in completing its outer shell or in pairing off its electrons. The inner closed shells contribute only to a correcting diamagnetism. The resultant magnetic moment of the atom is measured in Bohr magnetons (μ_B) and is dependent upon the motion and distribution of the odd electrons, that is, upon their momenta. Electrons can have orbital (L) and spin (S) momenta, which combine to give a resultant angular momentum (J). All of these are quantized, that is, they can only have certain values. The angle between the resultant angular momentum and the magnetic field direction can also only have $(2J + 1)$ discrete values. The gyromagnetic ratio, which is the ratio of angular momentum to magnetic moment, is $2m/e$ for orbital motion, m/e for spin motion and $2m/ge$ for the whole atom, where g, the Landé splitting factor, is dependent only on L, S and J.

In the Gerlach-Stern experiment a stream of free atoms from an electric oven passes through an inhomogeneous magnetic field and is received on a cold glass plate, the vapour pressure in the apparatus being low so that no collisions take place. Paramagnetic atoms will be both orientated and deflected, giving $(2J + 1)$ separate traces, the separation of which depends upon g. Hence the one experiment gives both angular momentum and magnetic moment of free atoms. Data so obtained agree well with those determined from spectroscopic measurements. A modification of the method can give the spin momentum and magnetic moment of the nucleus. Even for large atoms containing many protons and neutrons the largest nuclear spin observed is 9/2, indicating that the nucleus itself may have a shell structure, only uncompensated particles contributing to the resultant momentum. The magnetic moment of the proton is 2·85 nuclear magnetons ($\mu_N = \frac{1}{1840}\mu_B$), from which it appears that the proton itself may not be a single particle.

When the effective magnetic moments of bulk substances containing paramagnetic ions are measured, it is found that the rare earth salts give results which agree well with theory, whereas salts of the transition series have susceptibilities considerably lower than theoretical values. This is due to quenching of the orbital moments in the latter by electric fields due to neighbouring atoms; this effect may introduce asymmetry in the case of crystalline fields. The incomplete group in rare earth ions is largely shielded from such interaction by an outer completed shell.

Paramagnetic saturation can only be approached at very low temperatures using enormous fields and substances of large magnetic moment. At ordinary temperatures the susceptibility varies inversely with absolute temperature (Curie's law) or with the excess temperature above a critical value θ (Curie-Weiss law). In the latter case it appears as if, within the substance, there were an extra field adding to the effect of the external field. This inner field is much too large to be of purely magnetic origin and is attributed to exchange interaction between electrons of neighbouring atoms.

Below the Curie point, θ, it is possible for a spontaneous magnetization to exist in certain cases even in the absence of an external field. This magnetization, which varies from complete saturation at 0° A. to zero at the Curie point, is identified with the 'saturation' intensity of ferromagnetic substances appropriate to each temperature. Above their Curie points, all ferromagnetic substances are paramagnetic and obey the Curie-Weiss law. The intrinsic magnetization of a ferromagnetic is uniform in direction only throughout small regions or domains the average size of which is about 10^{-8} c.c., containing some 10^{15} atoms. The directions of magnetization of the various domains may be random and their resultant nil, but a small field is usually sufficient to align moments of individual domains. Single crystals have certain axes of easy magnetization which would appear to be the natural directions of spontaneous magnetization. Measurements of the gyromagnetic ratio prove that the elementary magnetic carrier is the electron spin. Heisenberg showed that intrinsic fields of the right order of size could arise from exchange interaction between electron spins. The condition for a large-scale alignment of spins is that the ratio of the distance between neighbouring atoms to the radius of the energy shell in which uncompensated electron spins exist shall lie within certain limits. The ratio has the right value for iron, cobalt, nickel, and for some of the rare earth metals; chromium and manganese lie just outside the range, but certain compounds and alloys containing these elements (notably the Heusler alloys) are ferromagnetic.

The first few atoms of an impurity do not markedly affect polycrystalline ferromagnetic materials, but if the number of dissolved atoms becomes larger than the number of domains, then even very small percentages of carbon, oxygen or sulphur can greatly lower permeability and increase hysteresis. The addition of silicon has the effect of causing these impurities to crystallize out in forms in which they are relatively less harmful. Much work has been done on the technical side in these directions, and in the preparation of 'soft' and 'hard' magnetic materials. Recent X-ray work has revealed why it is that alloys prepared under certain conditions of heat treatment make excellent permanent magnet material.

OBITUARY

Mr. Wilfred Trotter, F.R.S.

IN the recent autumn the Royal Society has suffered the loss of both of its fellows whose work lay in surgery, Harvey Cushing of America, who died on October 7, 1939, and Wilfred Trotter of London, who died on November 25 at the age of sixty-seven. Each had done conspicuous work in the surgery of the brain, approaching their problems with physiological thought, and Cushing's name will always be remembered for the studies by himself and his pupils on the pituitary gland and on the microscopic structure of brain tumours in reference to their ways of malignant growth. He was a pioneer in cerebral surgery in America, and his supreme powers both as an operator and as a scientific thinker soon gathered around him at Harvard a school of workers who will assuredly maintain the energetic influence left by Harvey Cushing's mind. The possibility of this broadly based success was a reward of the changes deliberately planned in American universities in order to enable a leader in medicine or surgery to receive all such laboratory and other advantages as a professor of physiology would expect in his department for the progress of scientific work and teaching.

Trotter was too early in England for such an opportunity, and much of his life was perforce spent in individualistic effort as a consulting surgeon. At University College Hospital he inherited the field of Sir Victor Horsley's work and soon proved himself to be a master of the surgery of the brain and of the thyroid gland. He wrote a general analysis of the physiological processes involved in cerebral concussion which influenced surgical thought widely. A new approach to the difficult tumours of the pharynx was devised by him, and in this and equally in all the familiar operations of surgery he worked with such technical perfection and delicate care of every detail for the welfare of both wound and patient that none could surpass his results. Practice as a London consultant grew rapidly, and from 1932 onwards Trotter had the honour of being sergeant surgeon in succession to three kings of England. But at that zenith of individual success he made a choice which to ordinary ambition seemed utterly paradoxical. His health was becoming unequal to the fullest strain of work, and so about 1934 he withdrew, not from unpaid hospital duties at his medical school, but from all private practice. He wished, while he still could, to teach the young men.

Trotter's influence on those around him at University College Hospital had at all times been profound. The fine lines of his face and the quiet perfection of everything said or done by him were united with a keenness of intellect that was stirringly eager to aid the minds of others and never stood aloof. His method was like that ascribed to Socrates, a conversation in which he would relentlessly, yet never with discourtesy or overbearing force, compel those sharing it to think afresh, to see through time-worn phrases, and to discover the foundations, if any, of their beliefs. Any question would serve him for the method—surgical, medical, ethical, or artistic; and a light irony would always keep the talk at human levels. He seemed to have realized completely the old precept "Know thyself", and through that discipline to have gained the power to influence the minds of all others.

Trotter's intense interest in the human mind inspired the first as well as what chanced to be the last of his publications ("Has the Intellect a Function ?", *Lancet*; June 24, 1939). In 1905, when demonstrator of anatomy at his medical school and waiting in the hope of appointment to the surgical staff, he produced none of the conventional apprentice papers in surgery but wrote for the *Sociological Review* an illuminating article on herd instinct. This was enlarged and republished in 1915 as a small book analysing the mentalities of nations then at war. Describing himself in it as a biological psychologist, he sought to compare with objective detachment the workings of the mind and of instinct in man and in animals, and he found associated with the gregariousness of man and of many creatures a powerful herd instinct that could be used to explain much in human behaviour.

But his surgical training and his exact sense of scientific values made Trotter reluctant for speculation that could not be tested by observation, and his later writings on such questions were those of a wise philosopher surveying the world of medicine rather than of a formal psychologist. The question of pain often occupied his thoughts, and during the earlier period when he had some leisure for experimental work he published in the *Journal of Physiology*, 1909, an important series of observations made with Morriston Davies on the nature of the sensations found during restoration of function of various skin nerves that had been deliberately cut in themselves. This work was done to test the generalization as to the existence of separate epicritic and protopathic nerves that Head and Rivers had made upon one experiment. Afterwards Trotter himself suggested a most attractive generalization, that pain arose when body tissues were in contact with naked and uninsulated nerve fibres; but then he had no leisure to test his view experimentally nor pupils to whom he could give the problem.

For a period, 1935–37, that was too brief and too late for work of his own, Trotter accepted the post of director of the Surgical Unit at University College Hospital as a temporary successor on the retirement of Prof. Choyce, because he regarded the welfare of such departments as of the highest value to a medical school. His eminence as a surgeon naturally gave him a seat for many years on the Council of the Royal College of Surgeons. He also served clinical science by his membership of the Medical Research Council during 1929–1933; and he was twice chosen for the Council of the Royal Society, on the second occasion being named as a vice-president. Trotter never avoided committee work, for he was eager to guide practical progress. But he cared little to popularize his name in general surgery, and the writings by which he became more widely known in the medical world were his short papers and addresses on the general theme of medical science. They gave his message of the need for clear thinking. But few men have the power to think as penetratingly as Trotter could always do, or to state their thoughts with such clearness and perfection of language.

T. R. E.

WE regret to announce the following deaths:

Mr. W. A. S. Calder, president of the Institute of Chemistry, on January 6.

Dr. W. B. Worthington, formerly engineer-in-chief of the Midland Railway, president of the Institution of Civil Engineers during 1921–22, on December 29, aged eighty-five years.

NEWS AND VIEWS

Margarine

Now that rationing of certain articles of diet has begun in Great Britain, interest is naturally being concentrated on substitute foodstuffs. In the recent past, margarine has not enjoyed much popularity, even among the poorer people of the country. This has been due partly to a not too savoury history and partly, no doubt, to ignorance of its constitution and dietetic value. Present-day brands of margarine cannot be considered in any way *Ersatz* butter, but will, once prejudice has been eliminated by experience, prove complementary to the adequate amount of butter allowed under the present rationing scheme. At present, margarine is not being rationed; therefore until it becomes necessary to ration cooking fats, its greatest value lies in eking out our butter supplies.

The plain statement of facts about margarine in an article beginning on p. 53 of this issue of NATURE, by Prof. J. C. Drummond, should do much to allay suspicion of, and counteract ill-founded prejudice against, this important commodity. Prof. Drummond has been University professor of biochemistry in University College, London, since 1922, and his deep practical knowledge of biochemical and physiological problems is now being utilized by the Ministry of Food, to which he is attached. His account of the early history and later improvements of manufacture of margarine will be read with interest, while the description of vitamin reinforcements should convince those still sceptical that margarine is a valuable article of food not only from the point of view of nutrition but also from that of health.

Sir John Reith, Minister of Information

SIR JOHN REITH, chairman of Imperial Airways, Ltd., has been appointed Minister of Information in succession to Lord Macmillan; the way is thus open to bring into the House of Commons the minister in charge of a department the working of which has been severely criticized ever since it began to function on the outbreak of war. Sir John is perhaps better known as the director-general during 1927–38 of the British Broadcasting Corporation, having been managing director of the British Broadcasting Company which preceded it. Hence he was largely responsible for the guidance and development of the broadcasting service of Great Britain in its early and critical days, when its functions were ill-defined and its merits as a vehicle of entertainment, of news and of education for the masses were much debated.

Before he became associated with broadcasting, Sir John was for a short period general manager of the well-known engineering firm, Wm. Beardmore and Co., Ltd. This followed Government posts in charge of munition contracts after and during the War of 1914–18, in which he served with the Royal Engineers. Sir John is an engineer by profession, having passed through the Royal Technical College, Glasgow, and served a five-years engineering apprenticeship in Glasgow. He is a member of the Institution of Civil Engineers. While his professional knowledge was no doubt of service during his eleven years with the B.B.C., it was his forceful character and administrative ability which were outstanding; these, with his experience of public affairs and the Press, will be invaluable assets in the chief of a young department which is capable of making invaluable contributions to the influence and prestige of Great Britain and to the morale of the people at home.

The British Association

THE General Committee and the Council of the British Association held a joint meeting last week, at which Sir Albert Seward, the retiring president, handed over the chair of the Association to his successor, Sir Richard Gregory. It was reported that, by agreement between the authorities at Newcastle and the general officers of the Association, arrangements for the meeting of the Association which had been appointed to take place in that city next September were in abeyance, and that a meeting there was not contemplated, save in the event of an early peace.

The Committee of the Association therefore proceeded to a discussion of the desirability and possibilities of a meeting being held, in some modified form, and in some other place. As to desirability, there was general agreement; as to possibilities and places, various suggestions were put forward, and in the upshot the general officers were instructed to make the best arrangements they can for some sort of an abbreviated meeting. Whether as part of such a meeting, or independently, the potential activities of the Division for the Social and International Relations of Science will be taken into consideration. No action has been taken to appoint new sectional officers for the year; but the general officers were instructed to consult those who held such offices last year, and any others whose advice and help would be appropriate.

Scientific Workers and the Armed Forces

THE Ministry of Labour and National Service announces that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces. Such men have previously been able to join the Forces in their professional capacity, and the present relaxation of the schedule is designed to enable those whose services are not required in a professional capacity in the Forces or as civilians to volunteer for other forms of service. To secure that scientific workers shall not be withdrawn from civil work to the detriment of the national interest, and that an adequate reserve of scientific workers is maintained for essential services, the Scientific Research Committee of the Central Register Advisory Council will consider applications from volunteers with the view of ensuring that relaxation is granted only in suitable cases. Any reserved scientific worker who wishes to volunteer should apply to the Ministry of Labour and National Service (National Service Department), Montagu House, Whitehall, S.W.1.

Scientific Workers and the War

A SYMPOSIUM, organized by the Faculty of Science of Marx House, Clerkenwell Green, London, E.C.1, was held during the week-end of December 30–31, the title of the meeting being "The Position of Science and Scientists in the War Situation". No adequate assessment of the effect of the war is possible without some knowledge of the economic background, and this was afforded by Maurice Dobb in a paper entitled "The Economics of War Capitalism". It was with this background that the meeting held a discussion on the effects of the war on university research and education, opened by Prof. H. Levy. It was argued that the cost of the social services would be cut, and in this respect, the maintenance of the universities on the present scale would be regarded as an unnecessary luxury, with adverse effects on staff, students, and standards of education. Mr. Roscoe Clarke, in discussing the scientific social services, showed that the incidence of the same problems has been felt in the medical services. The emergency medical schemes have cut right across the normal medical services, already dislocated by the evacuation of schoolchildren. Prof. J. D. Bernal, in the concluding paper, dealt with the status of the man of science. The historical role of science in the development of capitalism was analysed, and the effect of the functions of the scientific worker on his status discussed; at the present time, the existing system cannot use to the full the science it has itself brought into being.

The general tone of the discussion as a whole was that scientific workers are more and more beginning to feel dissatisfied with the role of science and its present applications to human welfare, and that a material change, if not a complete break, will have to be made with the present economic system before science can be fully utilized. Concern at the insecurity of their own position in the immediate future is leading scientific workers to the view that a new type of scientific organization, based on the experience of the trade unions in the defence of the economic and cultural interests of large masses of the population, is becoming necessary.

The Earthquake in Turkey

As the railway between Sivas and the ruins of Erzinjan has now been repaired, it is possible to add a few more details concerning the Erzinjan earthquake of December 27, 1939 (see NATURE of Jan. 6, p. 13). From Ankara to Sivas and Tokat the damage has been done chiefly to the old and badly constructed buildings made from inferior material, whilst the better ferro-concrete public buildings of recent construction have escaped with cracks and minor damage; but from Tokat and Sivas to Erzinjan there has been practically complete destruction of old and new. The only 'oasis' of lesser damage thus far recorded has been at Kemah near Erzinjan, where some buildings still stand, though 548 buildings were wrecked and nearly 150 casualties caused. It appears probable that Kemah was built on more solid rock than the other towns in the area of approximately 15,000 square miles affected.

In the mountainous district between Amasya and Tokat there are ground fissures 12 yards wide, out of which are said to issue smoke and sulphur fumes and also jets of boiling water. There is as yet no direct news of some five hundred villages to the east of Erzinjan, although efforts are being made to reach them through a countryside covered to a depth of 12 ft. in snow. At Niksar, a rock pinnacle fell on the town, doing much damage, and there were few survivors in this place or in fourteen of the neighbouring villages, whilst on the Black Sea coast the towns of Kerasun and Ordu are reported to have suffered the greatest damage.

At Kew Observatory the first waves to arrive did so at 0h. 3m. 26s. G.M.T. and the maxima exceeded the limits of registration, the ground movement being greater than one millimeter in amplitude. Several severe after-shocks have occurred as well as hundreds of smaller ones. On January 1 there were seven severe after-shocks at Erzinjan, and a violent shock at 7 a.m. local time at Bergama in the west of Turkey. On January 2 at Yozgad there was a strong shock and 190 houses collapsed, though no casualties are reported. The after-shocks appear now to be decreasing in strength and number. Although the after-shock of January 1 was at Bergama, it is yet uncertain whether the floods in the Brusa and Smyrna districts of Turkey and in the Bilecik Valley (River Sakaria) had anything to do with changes in topography attendant on the earthquakes, nor whether the Kemal Pasha Dams and numerous river bridges were destroyed by the shocks or by the floodwaters, but if the meteorological conditions in the area did not cause the floods, they certainly enhanced them considerably.

Other Recent Earthquakes

ON December 21, San José (Costa Rica) suffered the most severe earthquake it has known since 1923. Buildings were cracked, including the cathedral, though no casualties are reported. The shock was recorded at Manila, at De Bilt (Holland), where the *P* wave arrived at 21h. 7m. 10s. G.M.T., and at Kew, where the first of three shocks in rapid succession arrived at 21h. 6m. 51s. G.M.T., the maximum ground amplitude at Kew being 0·42 mm. On December 22, considerable damage is reported to have been caused by earthquake shocks in Costa Rica, though no loss of life or other casualties are reported. These shocks were possibly after-shocks of the earthquake which rocked San José on December 21.

On December 22 also severe earthquake shocks were experienced in the South Sea islands of Molucca. On December 23 and 24 earthquakes and landslides, which were probably caused by the earthquakes, occurred in Java in the East Indies. In addition to the Anatolian earthquake of December 27, further shocks were registered at Kew Observatory on December 25 (2), December 28 and December 29. Further news concerning all these shocks is awaited from the areas concerned and from other seismological observatories. On January 2, early in the day, an earthquake shock was perceptible on the Ionian Island of Zante (Greece), though no damage or loss of life has been reported.

Potatoes in War-time

POTATOES are one of the most valuable sources of human and animal food in war-time, and it is of the greatest national importance that both the acreage devoted to this crop shall be increased and that the maximum yields shall be obtained. Questions of quality, colour and shape must now take second place and yield be the all-important aim of the grower. The National Institute of Agricultural Botany, Cambridge, has just issued a war-time edition of its Farmer's Leaflet No. 3, in which useful information to this end is supplied. Emphasis is laid on the necessity for using healthy seed, as otherwise attention to cultivation, manuring, etc., is of little value. A number of varieties are recommended for both early and main crops; but it is pointed out that to lift potatoes in an unripe condition is an unwarranted waste of tonnage in a time of emergency. As regards choice of varieties, most of those commonly grown are still recommended, but King Edward should be replaced by a heavier cropping kind such as Arran Banner, Arran Consul, Kerr's Pink, Majestic or Redskin.

The use of unsaleable potatoes for animal feeding is the subject of "Growmore" Leaflet No. 10, issued by the Ministry of Agriculture. All potatoes, whether to be used raw or cooked, should be washed before feeding, or digestive trouble may result. Raw potatoes can be used safely in moderation for cattle, dairy cows and sheep; but they are not suitable for young stock, horses or pigs. Cooked potatoes, however, can be successfully fed to pigs of all ages, and a table of suitable quantities is provided. Potato and potato and green fodder silage are other useful ways of utilizing waste tubers, particularly if some of them are slightly diseased, and simple methods for preserving them in this way are described. Nutritious food of a feeding value equivalent to about a quarter of its weight of barley meal, and suitable for sheep, cattle and pigs, can thus be produced.

Johann Friedrich Blumenbach (1752-1840)

JOHANN FRIEDRICH BLUMENBACH, a pioneer in anthropology and craniology, was born on May 11, 1752, at Gotha. He studied medicine at Jena under Soemmering and qualified in 1776 at Göttingen, where he was appointed extraordinary professor of the practice of medicine in the following year and full professor in 1778. In his thesis entitled "De generis humani varietate nativa" (1776), which according to Garrison is the starting point of modern ethnology, he based his classification of mankind upon the shape of the skull and the facial configuration as well as on the colour of the skin. As the result of his craniological investigations, he divided the human race into five great families: the Caucasian or white race, the Mongolian or yellow, the Malayan or brown, the Negro or black, and the American or red.

Blumenbach was a voluminous writer. His principal work, which was published in 1790–1820, was entitled "Decades 1–6 collectiones suae craniorum diversarum gentium illustratæ". He was also the author of "Handbuch der Naturgeschichte" (1779–80), "Ueber der Bildungstrieb und das Zeugungsgeschäft" (1781), "Institutiones physiologicæ" (1787), "Beiträge zur Naturgeschichte" (1790–1811), and "Handbuch der vergleichenden Anatomie" (1805). He was also the editor of "Medicinische Bibliothek" from 1785 until 1795, and contributed many articles to periodical literature. He was a fellow of the Royal Society, member of the Royal Academy of Sciences of Paris, and the recipient of many other honours at home and abroad. He died on January 18, 1840.

Neanderthal Man in Central Asia

A PRELIMINARY account of the discovery of skeletal remains of Neanderthal man in Central Asia is given by Dr. Aleš Hrdlička through the Smithsonian Institution of Washington. The remains—the skull of a child, with the lower jaw and all the teeth, and some of the bones of the skeleton in a fragmentary state—were found by Dr. A. Nokladnikov in a cave of the Gissar Mountains of Siberia. The discovery is of special importance, as not only is this the first example of Neanderthal man to be recorded from Central Asia, but it is also the farthest extension of the type eastward hitherto known. With the exception of the finds in Palestine, all previous specimens have been found in Europe. Dr. Hrdlička, who has had an opportunity of examining the material while on a visit to Siberia recently, regards it as one of the most important discoveries in anthropology of the last two decades, and further as lending support to his view that there is an overlap in skull pattern between Sinanthropus and Neanderthal man.

In an account of the find which Dr. Hrdlička received at first hand from those who were responsible for the discovery, it was stated that the cave deposits contained many splintered bones of deer, leopards, wild horses, goats, boars, marmots and birds. Many of these showed evidence of having been used in the manufacture of stone implements. Most of these implements were made of local limestone, but the finest were of jasper. Good material for implement-making, however, was scarce. Typical Mousterian scrapers and small pointed implements, chipped on one side, were associated with the animal bones, and both were in relation to fire-places. The human skeletal remains were imbedded in a sterile underlying stratum. An interesting feature of their disposal was that they were encircled by five pairs of goat horns, of which three were still united.

Psychology of the Initiate

An interesting sidelight is thrown on certain changes in mentality taking place after initiation by an examination of two series of drawings made by an Australian aboriginal boy, which have been recorded and reproduced by C. P. Mountford, acting ethnologist of the South Australian Museum (*Records S. Austral. Mus.*, 6, 2; 1939). The subject was one of two interpreters accompanying an anthropological expedition of the University of Adelaide to the Warburton Ranges of Western Australia in 1935. At the time of his engagement it was understood that he was a full initiate; but when an investigation of aboriginal art was being made, it was noted that when drawings of a secret character were being made by tribesmen, they were carefully concealed on his approach. His own drawings in the first series invariably represented objects of, or known to, European civilization.

This fact, coupled with his failure as an interpreter, led to inquiry, when it was found that initiation of the man had not been completed. Though circumcized, he had not been subincized, and consequently in all matters affecting tribal ritual he was virtually ostracized, while his behaviour consorted with that of younger members of the tribe. Full initiation, which was then carried out, induced a remarkable change in his outlook, behaviour, and what from one point of view was of greater moment, in the attitude of other members of the group. The youth assumed the attitude and behaviour of a senior of the tribe; he was no longer prevented from seeing ceremonial drawings and taking part in ritualistic discussions, while, it is interesting to note, his own drawings now depicted the ceremonial designs associated with, or recording tribal traditions. The author's comment is significant. He points out how any interference with tribal ritual by outside influence may prove an effectual bar to association with tribal society, while still not securing an admission to any real participation in white civilization. The lesson is instructive.

Supposed Risso's Grampus in the Mersey

THE importance that authorities in tidal districts be acquainted with the fact that, under an arrangement made some few years ago, all large cetaceans stranded on the shores of Great Britain should be offered to the British Museum before any decision is made to dispose of them, is well borne out by the unfortunate destruction of a rare cetacean recently stranded in the Mersey. The flood tide of December 10, stranded a large cetacean in the Mersey at Widnes, and various unofficial reports circulated suggested it to be a porpoise, dolphin, or killer whale. Immediately upon discovering that no local museum or university had been informed of the rarity, the Merseyside Naturalists' Association went to considerable trouble to collect all available evidence and photographs and to interview all people who had handled the specimen. Through some misunderstanding, it appears that although the customs authorities had told the transporter company who recovered the whale that any scientifically interested body could have it, the Upper Mersey Conservators took possession of the carcass the day following its stranding, cut it up into pieces and returned it to the river from one of their vessels.

Evidence which was gathered by the Merseyside Naturalists' Association strongly suggests that the animal was a Risso's grampus (*Grampus griseus*), of which there is no previous Lancashire or Cheshire record. The report of evidence it collected gives: Length, 11 ft. 2 in.; upper parts: dark grey, almost black, blotched and streaked plainly with greyish-white, dorsal fin broad and high; head: no teeth in upper jaw; lower jaw with a few rather blunt teeth spaced about 0·75 in. apart; lower jaw a shade shorter than upper jaw; whitish tinge to muzzle and greyish tinge to head; head large and swollen like that of pilot whale; underparts white, smooth; flippers long, narrow and pointed; tail flukes narrow. No scientific measurements had been taken owing to the surprising and unannounced destruction of the carcass, but a photograph taken by a local man had been secured. The specimen was still alive and blowing when stranded and roped.

The Meteorological Office

THE recently issued report of the Director of the Meteorological Office for the year ending March 31, 1939 (H.M. Stationery Office. 9*d*. net), is largely occupied with a description of changes of organization arising from the rapid expansion of the Office, due mainly to the expansion of the Royal Air Force; it contains also an account of the methods adopted for dealing with routine requirements of the different services and of civil aviation. For these reasons a more careful perusal of the report is necessary than has generally been the case in the past in order to find items of purely scientific interest, although, it is curious to note, the decision was made during the period under review, to make organized research a part of the normal work of the Office, instead of leaving research to individual enterprise on the part of the scientific staff.

The most important instrumental problem that has been pursued has been the development of the *radio-sonde* method of measuring the pressure, temperature and humidity of the atmosphere up to heights of 10 miles or more. The apparatus arrived at has been developed in collaboration with the National Physical Laboratory. It is carried by a free balloon, and transmits radio signals which are modulated in a manner dependent on the physical state of the atmosphere with which the balloon is surrounded at the moment. Fifty ascents were made, in most of which a Dines meteorograph was attached so that a check on the indications of the radio transmitter was available eventually on those occasions when the instruments were recovered. Much time was spent in trying to eliminate various sources of error that were encountered. Trials of a radio method of measurement of winds at great heights were continued, the method consisting of observations by two distant radio direction finding stations of the position of a small radio transmitter carried by a balloon. The main difficulty arose from the deflection of the radio signals by surface objects, which necessitated elaborate calibration. During the year under review the use of the cloud searchlight for rapid determination of cloud height at night was greatly extended. Improved specifications for pilot balloons were considered, with the view of avoiding the rapid deterioration experienced in hot climates, also improved methods of storage.

Terminal Velocities

DR. HERBERT CHATLEY prepared a paper on 'terminal velocities' for delivery to the Junior Institution of Engineers on October 13. It is now published in the December issue of the *Journal* of the Institution. In many engineering and physical problems of the present day, the question often arises as to the maximum velocity developed when a body falls in a fluid medium. To give a rough idea of the terminal velocities, Dr. Chatley compares the impact velocity of a stream-lined aerial bomb and the speed with which the finest clay suspensions settle in water. Between these speeds he considers the landing speed of parachutes, the fall of rain or oil-drops, the vertical current speeds necessary in coal dust or grain elevators, the suspension of sand or silt in rivers, and the settlement of dust particles in a room.

When an elevated body is released, it falls earthwards according to the law of gravitation. As it proceeds, the resistance of the air or water increases up to a definite value, namely, when this resistance equals the weight of the body. When this happens, the velocity remains constant and is called the terminal velocity. A sand particle one micron in diameter has a terminal velocity in water of about 0·001 mm. per second; in air it is about ninety times as great. One of the most useful applications of the terminal velocity is in the computation of the power required to sustain bodies when placed in a current of fluid. For example, in the elevation of grain from a hopper or ship's hold to a level somewhat above the receiver, out of which it flows to a second container (say, 50 feet lift), modern plants consume about 0·8 h.p. hour per ton. This represents a very low efficiency. In a vertical pipe a fluid ascends more quickly than a suspended material, their relative velocity being the 'terminal velocity' in this case.

A Zinc 'Famine'

ACCORDING to the *Electrical Contractor and Retailer* an idea was current a short time ago that a shortage of zinc was responsible for the recent famine in torch-batteries. This is not the case as there was plenty of zinc in Great Britain and the torch-battery famine was due entirely to the overwhelming Government and public demand for these accessories—and quite naturally so. When a large number of people suddenly resolve to carry flash-lamps, something like a temporary famine is unavoidable. During the life of an ordinary dry battery possibly five per cent of the zinc is consumed and so about 95 per cent of the zinc used for this service is thrown away. It looks as if we were surrounded by an appalling waste in various directions. Notice, for example, the packing of tobacco and cigarettes for domestic use in 'tins' and then visualize the waste of iron and tin thereby involved. Many of these tins are also provided with substantial rubber seals, all of which are used once and then thrown away. It would be of interest if somebody considered whether this waste is serious or not, and if it is, then investigate how the saving could be effected.

Training Physicists

DURING the last six years there has been much discussion in the United States as to the most suitable training for physicists who are required in industry, and the conclusions come to have been summarized in these columns. In general, the training then available was considered to provide a superficial acquaintance with the latest developments of quantum theory and of atomic disintegration rather than a fundamental knowledge of the older physics. Criticisms of the same type were made in the May issue of *Metals and Alloys* this year and were quoted in the July issue of the *Journal of Scientific Instruments.*

In the November issue of the *Journal,* two physicists in the research department of a cable works in Great Britain point out that the criticism applies equally well to the training the universities of Great Britain provide, and that in consequence industrialists are reluctant to employ physicists. They think that the position would be improved if the universities provided some training in applied physics and supplemented it by visits to works and by practical experience in works during vacations.

Fused All-Glass Cells

MESSRS. TINTOMETER LTD., of Salisbury, announce the manufacture of a range of fused all-glass cells suitable for holding liquids for colorimetry, photometry, polarimetry and other purposes. The construction of the standard type consists of a body of a single bend of glass with faces of clear glass sintered to it. This avoids the use of the usual cements, which often break down under the attack of alkalis and other solvents. It is claimed that the accuracy of the thickness is within ± 4 × 10^{-3} in. for cells of one inch or less ; moreover, examination shows that distortion of the faces in the sintering process has been very largely avoided. Beside the standard types, hollow cubes, prisms, rectangular cells, double light-filter cells, and 'blood' cells are also being manufactured. It appears that these products will form a useful addition to the range of such articles manufactured in Great Britain.

Rhodes Scholars

THE "Statement of the Rhodes Scholarships" for the academic year 1938–39 shows that 68 scholars began their English experience, while 188 were in residence. Among the subjects covered, natural science and medicine with 45 representatives, and jurisprudence and the Modern Greats school with 38 each are easily the most popular. Agriculture, forestry and music have solitary devotees. The record is good on the whole in academic distinctions, and includes several names well known in sport and athletics. The list of books published by men of the foundation is long. The Rhodes scholars include a dean of Christ Church and a regius professor of medicine. They come to England with previous academic training and at an age more advanced than that of the average undergraduate. The question whether this discrepancy is advisable has been the subject of considerable comment.

Scientific Research in India

THE progress of research in India can be followed by the help of the *Indian Science Abstracts,* which is an annotated bibliography arranged by subjects. Some of these bear closely on the economic development of the country, and their principal interest is local rather than general. Part 1 for the year 1937 covers mathematics, physics, geology and botany (National Institute of Sciences of India, September 1939). Mathematics has 86 papers, five of which deal with Indian geodesical problems, physics has 189, only a dozen of which deal with local meteorological or geophysical subjects; geology has 316 and botany 286, dealing almost exclusively with Indian problems.

Alchemical Manuscripts

VOLUME 6 of *Osiris,* dedicated to Prof. Bidez, contains his portrait and a bibliography of his publications. The rest of the volume of 844 pages consists of a "Catalogue of Latin and Vernacular Alchemical Manuscripts in the United States and Canada" by W. J. Wilson, of the Library of Congress, Washington. After a brief but very interesting general introduction, the text consists of detailed and annotated analyses of 79 manuscripts, with 41 facsimile figures. The dates of the manuscripts range from the thirteenth to the nineteenth centuries. Many of them contain collections of recipes. There is a very full index (pages 690–844). The work is thorough and reaches a high standard of scholarship it is a notable addition to the literature of a subject which has recently attracted a good deal of attention, namely, the history of alchemy.

Early Works on Medicine and Science

WE have received from Messrs. Goldschmidt and Co., Ltd., 45 Old Bond Street, W.1, their Catalogue No. 53 listing rare early works on medicine and science. Pride of place is occupied by a good and large copy in vellum of the first edition of William Harvey's "De Motu Cordis" (1628), and also a copy of the rare third edition of the same work. A complete set of Conrad Gesner's "Natural History" (1551), three of Kepler's important works, a work by Joseph Black on alkalis (1770) and William Withering's "An Account of the Foxglove" are also to be noted. A number of less rare though none the less important books and tracts by Erasmus Darwin, Euler, Faraday, Fayrer, Fraunhofer, Stephen Hales, Mendeléeff, Pasteur, Lister, Fox Talbot and many others are also listed.

Medical and Scientific Lending Library

PART 2 of the new edition of the "Catalogue of Lewis's Medical and Scientific Lending Library", revised to the end of 1937, has now been issued (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. 16*s.* net; to subscribers, 8*s.*). It contains the classified index of the subject-matter of the books, with the names of their authors, upon medical and scientific subjects contained in Lewis's Library. An extensive subject is subdivided to facilitate reference; for example, chemistry has eleven, and agriculture thirteen, sub-headings. The date of publication is given, and a note is frequently added to indicate the scope of the work. It will be appreciated what a large number of works is listed when it is mentioned that the text occupies 156 pages, each with three columns and each column containing authors' names of some 30–45 works. The catalogue should therefore prove a very useful general guide to medical and scientific books.

Big Sunspots

A BIG group of sunspots, originating about January 1 and growing rapidly, crossed the sun's central meridian on January 5 and reached the west limb on January 12. Between January 2 and 4, the area increased tenfold and measured 1,300 millionths of the sun's hemisphere on the latter date. Still expanding on January 5, the spots were clearly seen with the naked eye through the morning mist. In structure, the group was a typical stream with leader and follower spots and subsidiary spots in between. This group is the largest since last September, and indicates that, although the maximum of the 11-year cycle is past, the sun is still generally active.

Royal Institution Discourses

THE following Friday Evening Discourses have been arranged by the Royal Institution to be delivered before Easter. The discourses begin at 5 o'clock: January 19, Sir Leonard Woolley, "The Latest Excavations at Atchana in North Syria"; January 26, Sir Noel Ashbridge, "Long Distance Broadcasting"; February 9, Prof. L. C. Martin, "Ultra-Violet and Electron Microscopy"; February 16, Sir William Bragg, "Physics in War-time"; March 1, Lord Eustace Percy, "Peace-making after War: Past History and Future Problems"; March 8, Sir William Bragg, "Experiments from the Researches of Sir James Dewar"; March 15, Sir Frederick Keeble, "Agriculture and National Well-being".

Announcements

THE Harrison Lectureship Medal of the Pharmaceutical Society will be awarded to Mr. A. D. Powell at a meeting on January 9 at 7.30, when Mr. Powell will deliver the Harrison Memorial Lecture entitled "Drug Standards: their Development and Application".

THE next monthly meeting of the British Institute of Radiology will be held in the Reid-Knox Hall on January 19, at 2 p.m., when the following lectures will be delivered: Silvanus Thompson Memorial Lecture entitled "The Irradiation of Liquids", by Prof. F. L. Hopwood; Mackenzie Davidson Memorial Lecture entitled "Maternal Mortality and Radiology", by Dr. L. A. Rowden.

THE Friends of the National Libraries decided at their annual meeting to continue their activities during the War. Acquisitions during the year included a number of early and rare books on science presented to the Science Library at South Kensington, a volume of drawings by the architect, Edward Blore, of country houses and other buildings, given to the Royal Institute of British Architects, and the purchase of a collection of papers belonging to the publishing business of Robert Cadell, Stoneham and Houlston.

THE Paris Academy of Medicine has awarded the Jansen Prize to Prof. A. Bessemans, pro-rector of the University of Ghent, for his work on spirochætes.

THE Albert Brachet Prize of 12,000 francs is awarded every three years for the best work on embryology published during this period in English, French, Dutch, German or Italian. Further information can be obtained from the Secrétarie perpétuel de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, Palais des Académies, Brussels.

THE Emergency Executive Committee of the International Congress of Mathematicians has decided definitely to postpone until some more favourable date the Congress which was to have been held in Cambridge in September 1940.

A EURASIAN YOUTH MOVEMENT has been launched in Singapore with a scheme to uphold and improve the social, moral, physical and intellectual welfare of the Eurasian youth when they leave school.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 73. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anisotropy of Cellulose Sheet

IN view of the results just published by Spence[1] on the optical anisotropy of films prepared from various esterified celluloses, it may be of interest to record some recent measurements on 'Cellophane' (regenerated cellulose) sheet.

This material is observed to be optically bi-axial, the axes lying in the plane defined by the direction of extrusion and the normal to the sheet. The measurements made in this laboratory are not, as in Spence's case, direct measurements of birefringence, but are observations of the two principal refractive indexes in the plane of the sheet, and of the optic axial angle. From these the refractive index normal to the sheet and the birefringence have been calculated. Numerical results for two batches of material are given in the accompanying table, where θ is the angle between one optic axis and the normal to the sheet; n_γ is refractive index for electric vector along extrusion direction; n_β is refractive index for electric vector in plane of sheet at right angles to extrusion direction; and n_α is refractive index for electric vector along normal to sheet.

		θ	n_γ (obs.)	n_β (obs.)	n_α (calc.)	$(n_\alpha - n_\gamma) \times 10^5$
Acid and water-washed sheet	Wetted	43·0°	1·413	1·408	1·403	−1000
	Air-dry	45·7°	1·534	1·526	1·519	−1500
Sheet undried during manufacture	Wet	56·5°	1·382	1·377	1·374	− 800
	Freely dried	57·6°	1·531	1·521	1·517	−1400
	Stretched and dried	72·3°	1·535	1·521	1·520	−1500

For ready comparison with Spence's birefringence figures, the values for $(n_\alpha - n_\gamma)$ are given in the same units as used by him although, owing to the method by which the figures were obtained, they cannot have the same accuracy as his. They are not inconsistent, however, with the values to be expected—by extrapolation to zero acetyl content—from Spence's figures obtained on sheets prepared from cellulose acetylated to different extents.

It may be observed that, while the 'slow ray direction' and the direction of extrusion or stress are coincident in the regenerated cellulose sheet, Spence found them (with one exception) to be at right angles in sheets made from cellulose esters with various acyl groups. Moreover, in cellulose sheet, increase of the stress along the direction of extrusion leads to increase in the negative value of $(n_\alpha - n_\gamma)$, in contrast again to the behaviour of the esters.

These differences are probably to be ascribed to the absence of acyl side chains in regenerated cellulose, since any 'selective' orientation that may be induced by stress will presumably have less effect on n_α and n_β in cellulose than in its esters. The values of n_α and n_γ in the material examined are nevertheless both increased by stress, while n_β remains remarkably constant.

D. G. DRUMMOND.

Photochemical Department,
British Cotton Industry
Research Association,
Manchester.
Dec. 8.

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[1] Spence, J., *J. Phys. Chem.*, **43**, 865 (1939).

Heat Conductivity of Rubber at Low Temperatures

WHILST examining the possibilities of applying rubber in low-temperature work, we were hampered by the lack of available data of its physical properties at low temperatures. We were quite aware of the difficulties to be expected in making accurate measurements in that temperature region, and this applies specially to the heat conductivity in which we were particularly interested. In order to obtain at least an estimate of the order of magnitude, we carried out some measurements of the heat conductivity of commercial rubber (tyre rubber, North British) at room temperature and the temperature of liquid air.

We used (1) the standard method (heat transmission through a thin sheet) at both temperatures with a small vacuum apparatus which had a circular cross-section of about 7 cm.^{2}; the specimen had a thickness of 0·9 mm.; (2) we checked the low-temperature measurement by the following method: a bag of the same rubber was immersed in liquid oxygen and filled with liquid nitrogen. The rate of evaporation of the nitrogen was measured and, together with the dimensions of the bag, allowed of an independent determination of the heat conductivity. The mean values obtained by both methods are as follow:

T	293°K.	83°K.
cal./sec.cm.°K.	0·00055	(1) 0·000018
		(2) 0·000010

This considerable drop in the heat conductivity to, say, one fortieth from room to liquid air temperature does not seem to be confined to this particular rubber, as other specimens which we subjected to rough measurements show a similar behaviour.

ADOLF SCHALLAMACH.

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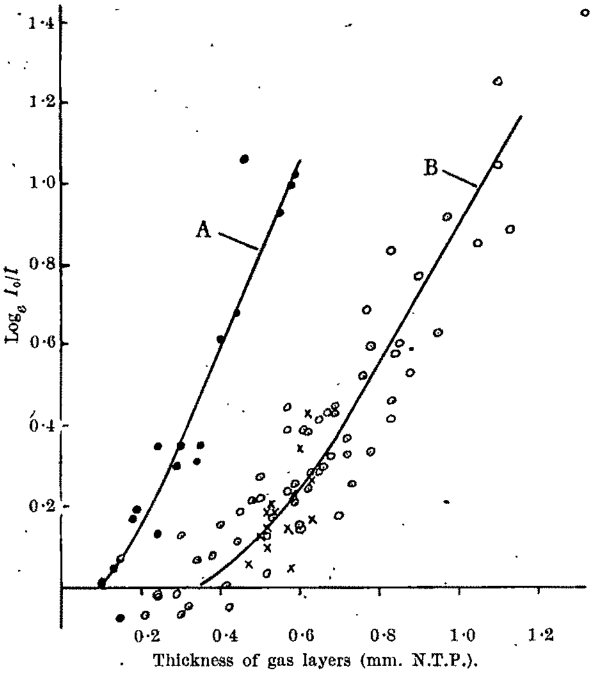
Dec. 18.

Absorption of Hydrogen Lyman Radiation by Atmospheric Gases

THE absorption of the hydrogen resonance line at 1215·7 A. has been investigated to obtain more exact information bearing on the theory of the production of short-wave radio fadeouts by solar eruptions[1]. The following results have been obtained:

(1) Nitrogen is transparent in layers up to 3·2 mm. thick (N.T.P.), in agreement with the early observations of Hopfield[2] and more recent measurements by Preston[3].

(2) Exact measurements on water vapour were difficult, but more than half the incident radiation is absorbed in a layer about 0·05 mm. thick. This agrees with Preston's observations.



●, oxygen; ⊙, air (energy in disruptive charge, 6 watts); ×, air (energy in disruptive charge, 3 watts).

(3) The absorption in oxygen and air was found to be much heavier than was expected from previous work. In the region where absorption commences, the densities of the parts of the hydrogen line in the absorption spectrum and the check spectrum without absorber, which was put on the same film, were compared directly as an approximate measure of the absorption. Lack of the characteristic curves for the emulsion should not cause serious errors in the comparison of nearly equal densities.

In the accompanying figure, Curve A shows the absorption of molecular oxygen in layers up to 0·6 mm. thick (N.T.P.). The ordinates are $\log_e I_0/I$ (I_0 being the unabsorbed and I the absorbed intensity); in the usual formula for mass absorption, $\log_e I_0/I = \mu x + c$. Since absorption appears to start only when there is a minimum gas layer amounting to about 0·10 mm., then c is not, in this case, zero. In addition, the absorption coefficient, μ, may not be constant for small values of the absorption.

Curve B shows the absorption in air. Several points falling below the axis of zero absorption indicate the possible magnitude of individual errors, and the general scatter of observations makes it difficult to define the absorption curve accurately. Its slope, however, is not constant, and again, there is no absorption until a minimum layer of gas is present. This minimum appears to be between 0·30 and 0·40 mm. (N.T.P.) and is not exactly five times the minimum in oxygen. For the strong bands at 1140, 1245 and 1450 A. absorption is clearly apparent in the least amounts of gas used for observations on 1215·7A.

The absorption coefficients given for oxygen and air by Preston are about fifty times less. In the present case the absorbing gases were pure to within three parts in a thousand, and, in addition, water vapour, the most powerful absorber, was ruled out as an unobserved impurity by check experiments with saturated nitrogen. It is possible that Preston's observations were in error owing to serious dissociation of the oxygen in his apparatus (cf. the difficulties experienced by Ladenburg and van Voorhis[4]). In the present case reduction to half the energy dissipated in the discharge caused no observable difference in the absorption measurements, showing that dissociation of the oxygen was negligible.

With a fixed absorption path the pressure is varied in order to change the thickness of the absorbing layer, and it would appear from the two curves, therefore, that the partial pressure of the oxygen in the spectrograph is the factor determining the onset of absorption. This minimum pressure is about 0·04 mm. If absorption of 1215·7 A. is only possible when an oxygen molecule is in a slightly perturbed state owing to its collision with another oxygen molecule, the absorption coefficient should vary as the square of the pressure until the population density of absorbing molecules is constant. In oxygen at very high pressures, Shalow and Steiner[5] have found absorption bands which behave in this way, and attributed by them to the temporary formation of O_2–O_2 molecules.

If λ 1215·7 is emitted from the sun, no absorption will take place until it reaches levels in the upper atmosphere where the partial pressure of molecular oxygen is about 0·04 mm. (about 80 km.), except for attenuation due to the small amount of water-vapour above this height. According to the shape of the 'tail' of the absorption curve, the radiation would be absorbed more or less rapidly in dissociating oxygen molecules and producing ionization according to the process previously suggested[1]. The resultant ionized layer would perhaps correspond to that found by Budden, Ratcliffe and Wilkes[6].

This work has been made possible through a grant for research made by the Commonwealth Government.

S. E. WILLIAMS.

School of Physics,
University of Sydney, N.S.W.
Nov. 30.

[1] Martyn, Munro, Higgs and Williams, NATURE, 140, 603 (1937).

[2] Hopfield, *Phys. Rev.*, 20, 573 (1922).

[3] Preston, *Phys. Rev.*, 55, 1125, 1939 (abstract only). An attempt to communicate with Mr. Preston privately regarding the discrepancy was unsuccessful.

[4] Ladenburg and van Voorhis, *Phys. Rev.*, 43, 315 (1933).

[5] Shalow and Steiner, *Z. Phys.*, 99, 137 (1936).

[6] Budden, Ratcliffe and Wilkes, *Proc. Roy. Soc.*, A, 171, 188 (1939).

Does the Mesotron Obey Bose-Einstein or Fermi-Dirac Statistics?

WHETHER the mesotron obeys Bose-Einstein or Fermi-Dirac statistics is closely associated with what one assumes regarding the nature of the field, emission and absorption of which by the heavy particle is responsible for the interaction between elementary nuclear particles. If the field be a one-particle field, as postulated by Yukawa[1], the mesotron obeys Bose-Einstein statistics, and has a spin equal to unity (All momenta are expressed in units of $\hbar$.) However, in view of the fact that all known elementary particles obey Fermi-Dirac statistics and possess a spin $\frac{1}{2}$, one is rather reluctant to accept, unless experimental evidence points that way, that the mesotron obeys Bose-Einstein statistics and has a spin equal to unity. If we could suppose that the field involved is a two-particle field instead of a one-particle one, Fermi-Dirac statistics and a spin of $\frac{1}{2}$ could be attributed to the particle concerned. So we suppose that the mesotron is emitted or absorbed by a heavy particle always in conjunction with a neutrino or an antineutrino. In symbols

$$\begin{aligned} P &\rightleftarrows N + \eta^{+} + n^{-} \\ N &\rightleftarrows P + \eta^{-} + n^{+} \end{aligned} \qquad (1)$$

where N and P stand for a neutron and a proton respectively, n^{-}, n^{+} for a neutrino and an antineutrino, and η^{-}, η^{+} for the negative and the positive mesotron, which now obey Fermi-Dirac statistics and possess a spin of $\frac{1}{2}$.

If we start with a neutron and a proton at $\vec{r}_1$ and $\vec{r}_2$ respectively, processes (1) obviously lead in the second approximation of the perturbation theory to an exchange interaction between the nuclear particles. If we suppose that the spin of the heavy particle is not affected during (1), the exchange force is purely a Heisenberg force; if, on the other hand, the spin of the heavy particle is reversed during (1), we get a purely Majorana force, so that the correct spin dependence of nuclear forces is obtained by choosing for the interaction between the heavy particles and the mesotron-neutrino field a form which combines the above two.

The forces between like particles, which are known[2] to be of the same order of magnitude, for anti-parallel spins at least, as the force between unlike particles, can likewise be explained by introducing the neutral counterpart of the mesotron.

The phenomenon of β-decay can be fitted into this theory if it is assumed that the mesotron disintegrates into a β-particle and a γ quantum; so that the emission of a β-decay particle during a β-decay is accompanied not by a neutrino alone, as on Fermi's theory, but also by a γ quantum. This departure from Fermi's theory should enable us to explain in a more satisfactory way the energy distribution curve for the β-particle transformation.

Detailed calculations will be published elsewhere.

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[1] Yukawa, *Proc. Phys. Math. Soc. Japan*, 1748 (1935).

[2] Tuve, Hafstadt and Heydenburg, *Phys. Rev.*, **50**, 806 (1936); **53** 239 (1938)

Interpretation of Nebular Red-Shifts

IN a recent communication[1], M. E. J. Gheury de Bray discusses the possibility of explaining the red-shifts by assuming that the velocity of light (c_T) is constant throughout the universe at any given time but decreases with time (T).

This hypothesis implies the assumption (*a*) that the atomic frequencies remain constant throughout space and time and may therefore be used as clocks (atomic clock '*AC*') for time measurements; (*b*) that measuring rods, other than light years (which contract with a decrease of c_T), can be found. For such measuring rods we may now choose the distances of *the material points* (for example, the nebulæ) in the universe, as according to the hypothesis the universe neither expands nor contracts. Such measuring rods we call 'material rods' ('*MR*').

It shall be shown here that the proffered hypothesis, based on the measuring system $AC + MR$, is one of three alternative ways of formulating the hypothesis of the expanding universe.

The following clocks and measuring rods can be taken as basis of a measuring system for cosmological purposes:

(*a*) Clocks	(*b*) Measuring rods
AC (atomic clocks); *or*	*MR* (material rods); *or*
LC (light-clocks: the time taken by light over a given distance—*c* is here assumed as constant).	*LR* (light-rods, for example, light years: the distance covered by light in a given time—*c* is here assumed as constant).

Only the following three combinations of these clocks and measuring rods can be taken as basis of a measuring system: $AC + MR$, which is the basis of Mr. Gheury de Bray's hypothesis; $AC + LR$, a basis which leads to the expansion theory of the red-shifts, and $LC + MR$, which leads to what Milne[2] calls 'dynamical time scale', and to the 'speeding up' theory of the red-shifts.

($AC + LR$). The theory of the expanding universe states that the distances between material points, measured in *LR*, increase; in other words, it maintains an increase of *MR* against *LR*. This leads to the recession of distant nebulæ and to the Doppler effect. The identity of the frequencies of characteristic spectral lines throughout the universe (atomic clocks) is thereby assumed; the measuring system of the theory is thus the $AC + LR$-system. In tracing back the recessive movements it is found that $1{\cdot}86 \times 10^9$ years ago the size of the universe was zero. Thus an absolute scale of time T (based on the atomic clock) is assumed in which the unit is the (atomic) year and the *present value* of T is $T_P = 1{\cdot}86 \times 10^9$. (This 'age of the world' is confirmed by other measurements based on atomic radioactivity clocks.)

($AC + MR$). The above statement that *MR* increases if measured in *LR* is equivalent to saying that *LR* decreases if measured in *MR*. If *MR* is chosen and the clocks are not changed, the system $AC + MR$ is adopted. The decrease of *LR* means a decrease of the velocity of light (measured in *MR*). This permits an explanation of the red-shift of old light, since c_T was greater at the time $T - \Delta T$ when it was emitted and therefore $\lambda_{T-\Delta T}$ is longer than λ_T.

($LC + MR$). There is a third way to express the same facts. If we allow the light a longer time for its voyage, by defining our clocks in such a manner that they are slowing down as compared with the atomic clocks, then the decrease of c can be made to disappear. In other words, we adopt a new time scale τ in which the atomic frequencies throughout the universe are speeding up; this explains the red-shift of old light.

The three alternative ways of expressing things agree in regard to the observable effects they describe. All predict the red-shift of old (distant) light. All therefore also predict a violet shift of characteristic spectral lines in the course of time to come (in $AC + LR$, that is, in the expansion theory, this has to be explained by an expansion of the spectroscope's grating). The three theories are logically equivalent, and therefore do not describe alternative *facts*, but the same facts in alternative *languages*. (To ask whether 'in reality' the universe expands, or c decreases, or the frequencies speed up, is not more legitimate than, when prices of goods fall throughout the economic system, to ask whether 'in reality' the value of money has increased or the value of the goods has decreased.) Nevertheless, the $AC + MR$-language seems to offer a particularly simple mathematical treatment and, furthermore, an *observational approach* to Milne's 'dynamical' time scale. It shall therefore be briefly examined.

In $AC + MR$, where characteristic atomic frequencies are assumed constant and c_T depends in some way upon T,

$$(1) \qquad (d\lambda/\lambda)_{T+\Delta T} = (\Delta c_T/T)_{T+\Delta T};$$

on the other hand, the observational law of red-shifts (velocity-distance relation) can be written:

$$(2) \qquad (d\lambda/\lambda)_{T_P-\Delta T} = (\Delta T/T)_P,$$

if the 'apparent distance' in light years, calculated on observed luminosities, is identified with ΔT. From (1) and (2) we get

$$(3) \qquad (\Delta c_T/\Delta T)_P = (dc_T/dT)_P = -(c_T/T)_P.$$

Generalizing this and integrating we get the law of the decrease of c:

$$(4) \qquad c_T = c_P T_P/T.$$

If we proceed from $AC + MR$ to $LC + MR$, we have to introduce a time scale τ so that $c_\tau = c_P =$ constant. In order to get the general formula for $d\tau/dT$, we make use of (4), which can now be written as

$$(5) \qquad d\tau/dT = c_T/c_\tau = c_T/c_P = T_P/T;$$

integrating and choosing $\tau_P = 0$ (Milne chooses $\tau_P = T_P$), we arrive at

$$(6) \qquad \tau = T_P \log(T_\tau/T_P),$$

which is essentially Milne's formula (A)[2]; the index 'τ' in 'T_τ' indicates the value of T at the instant τ of the τ-scale. Equivalent to (6) is $T_\tau = T_P e^{\tau/T_P}$. From this and (5) we get the law of the 'speeding up' of characteristic frequencies when measured in $LC + MR$, that is, on the τ-scale:

$$(7) \qquad \nu_\tau = \nu_P dT_\tau/d\tau = \nu_P e^{\tau/T_P},$$

and from this and $c_\tau = c_P$ we get, corresponding to (2), the law of red and violet shifts in the form

$$(8) \qquad (d\lambda/\lambda)_{\tau+\Delta\tau} = -\Delta e^{\tau/T_P}/e^{\tau/T_P} = -\Delta T_\tau/T_\tau.$$

In the above deduction we have identified the 'apparent distance' (calculated on observed luminosities, that is, energy densities ρ, and not corrected for departures) with ΔT. Thus our assumption regarding ρ is that it measures the square of the *time* ΔT the light travels, which in $AC + MR$ cannot be identified with the ('real') *distance* r; for as the light was quicker when it was emitted, $r > \Delta T$. If the usual assumption that ρ measures not $(\Delta T)^2$ but r^2 is upheld, our deductions would have to be altered and we would neither get (4) nor its equivalent (6), that is, Milne's scale of τ. Vice versa, if our assumption regarding ρ is upheld and if we consequently arrive in $LC + MR$ at Milne's τ-scale, in which $r = \Delta\tau$, then neither r^2 nor $(\Delta\tau)^2$ can be taken as being measured by ρ. Whether this behaviour of ρ in τ can be deduced *a priori* in Milne's theory I do not know. But available *empirical* data seem to speak at least not against our assumption that $(\Delta T)^2$—which is smaller than r^2—is a measure of ρ, for "present evidence points to observed luminosities (ρ) decreasing with distance *not even quite as rapidly* as we should expect. . . ."[3].

K. R. POPPER.

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Nov. 27.

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[1] NATURE, 144, 285 (1939).

[2] Milne, E. A., *Proc. Roy. Soc.*, A, 158, 327.

[3] Schroedinger, E., NATURE, 144, 593 (1939).

"The Relationship between Pithecanthropus and Sinanthropus"

THE article by Dr. G. H. R. von Koenigswald and Prof. F. Weidenreich on the relationship between Pithecanthropus and Sinanthropus in NATURE of December 2 is eminently satisfactory to those anatomists who have not been able to understand why these two hominids should ever have been separated generically. Probably my colleague, Dr. S. Zuckerman, was the first to express doubt on the justification for this distinction, in an essay on Sinanthropus[1], and I have on more than one occasion urged that the Peking hominid is but a Chinese variant of Pithecanthropus[2].

While for some years Prof. Weidenreich, with his first-hand knowledge of the Chinese fossils, has been insisting on their supposed distinctive characters, and has put forward the thesis that they represent an early type of man still more primitive than Pithecanthropus, he now agrees not only that Pithecanthropus and Sinanthropus "are related to each other in the same way as two different races of present mankind", but also that in some significant characteristics Pithecanthropus is the more primitive of the two. If these conclusions are accepted (as they certainly should be) it now becomes necessary finally to discard the generic term Sinanthropus. The Chinese fossils should logically be referred to the species *Pithecanthropus erectus*, or, if it should be thought more desirable as a temporary convenience for purposes of reference, they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*.

The article of Dr. von Koenigswald and Prof. Weidenreich raises again the whole question of the validity of the morphological evidence upon which physical anthropologists often seem to depend for their taxonomic conclusions. For example, the authors use the remarkable argument that, because the femora ascribed to Pithecanthropus of Java show a marked degree of platymeria such as is not found in the femora of 'Sinanthropus', therefore they probably do not belong to Pithecanthropus. This statement would provide a pretty exercise in logical analysis. A similar process of reasoning would also lead to the conclusion that, because a femur excavated from a Neolithic barrow shows more platymeria than the femur of a modern Englishman, therefore it cannot belong to *Homo sapiens*! In any event, an acquaintance with recent literature might have informed the authors of a short, but not unimportant, paper by the late Dr. Dudley Buxton on platymeria and platycnemia[3] in which evidence is adduced in support of the thesis that these characters may have a nutritional basis, and no racial significance.

W. E. LE GROS CLARK.

Department of Human Anatomy,
University Museum,
Oxford. Dec. 17.

[1] *Eugenics Rev.*, **24** (1931).

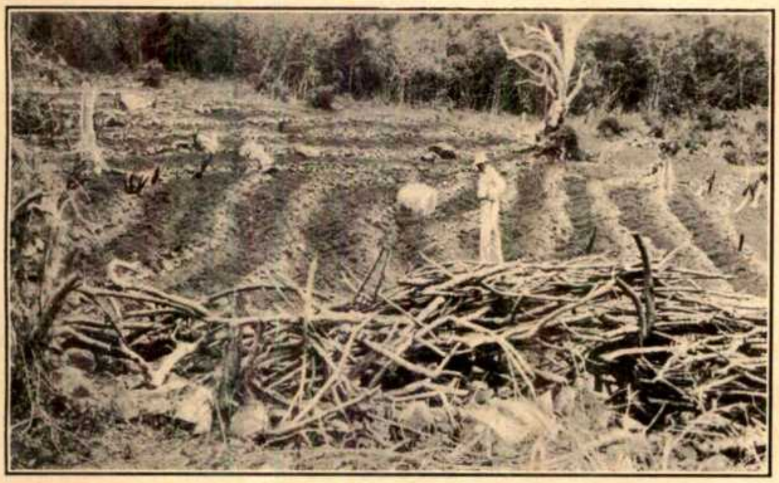
[2] *Man*, 60 (April 1937); *Modern Quarterly*, 115 (April 1939); Presidential Address, Section H, British Association, 1939.

[3] *J. Anat.*, **73**, 31 (1938–39).

Influence of the Geology of the Virgin Islands on Local Agricultural Practices

WITH the exception of Anegada, Santa Cruz, and part of Virgin Gorda, the Virgin Islands are hilly and rugged. There is in most cases a long narrow backbone rising to about 1,000 ft. with numerous lateral spurs sloping steeply to the sea. Owing to centuries of cultivation and charcoal burning, there is no virgin forest. The predominant vegetation is dense secondary bush in various stages of seral development. Many of the hills are stark naked, while others exhibit a sparse retrogressive xerophytic vegetation.

According to Earle[1] and Hardy[2], the islands are largely composed of enormously thick dynametamorphosed sedimentary tuffs lifted up from the ocean bed by volcanic forces. To quote Earle: "The effect of these dynamic forces has been to lift the sedimentary beds bodily on end into a highly inclined position without obliterating the original stratification. These stratified metamorphic beds which cover by far the greater part of the presidency invariably strike East and West, which fact is doubtless responsible for the alignment of the islands in that general direction. They always dip very steeply, varying from 45° to 90° South and averaging 70°."



The tops of these highly inclined beds have frayed off and are scattered down the slopes in the form of flags of various sizes mixed with soil derived from them. This soil ranges from gravel to loam. The surface is thickly covered with denuded and weathered fragments. Such land at first sight appears extremely inhospitable. Yet owing to the scarcity of flat land, most of the cultivation is done on these talus slopes, which offer certain unique advantages.

After felling the secondary forest, the first step in the preparation of the land is the separation of flags from the soil. The disposal of the flags presents a problem which is easiest solved by placing them in rows along the contours. This is a common practice among the peasants. A few more alert individuals have made better use of the peculiar advantages to hand and have gone in for stone terracing out and out. Needless to say, all manner of terracing is seen, from the primitive arranging of stones in rows to admirable terraces.

To conclude, it will be seen that much of the land in the Virgin Islands can be stone terraced by the peasant himself at no cost apart from his labour. So far as I am aware, no inducement is offered to peasants in the British Virgin Islands to undertake such permanent improvement of their land.

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[1] Earle, K. W., "The Geology of the British Virgin Islands", *Geol. Mag.*, **61**, No. 722 (August 1924).

[2] Hardy, F., "Notes on the Geology and Soils of the British West Indies", Imp. Coll. Trop. Agric., Trinidad (1938).

Dioximaleic Acid Oxidase Action of Peroxidases

Banga and Szent-Györgyi[1] recently described a new enzyme, dioximaleic acid oxidase, which catalyses the aerobic oxidation of dioximaleic acid to the corresponding diketo acid.

It was shown in a previous paper[2] that hydrogen peroxide must play an important part in the mechanism of the ferment, because catalase inhibits the reaction between oxygen, ferment and dioximaleic acid completely.

We have undertaken preparations and purifications of the dioximaleic acid oxidases from different plant sources, such as *Rumex acetosa*, *Fraxinus excelsior*, *Prunus Padus*, *Syringa vulgaris* (leaves); horse-radish roots and cauliflower. Many different purification methods were used, as fractional precipitations with salts and organic solvents, absorptions, electrophoretic experiments and others. The removal of impurities by precipitation with lead acetate was especially successful in many cases. Thus the activity of the cauliflower juice was increased in one operation eight thousand times. Very high degrees of activity were obtained, that is, 40,000 c.mm. of oxygen per minute per mgm. of ferment from horse-radish. The starting materials showed activities of 1 to 10. All of the purified preparations showed the typical peroxidase spectrum, 645, 550 and 500 mμ[3].

The ratio dioximaleic acid oxidase/purpurogallin number always remained practically constant in spite of all our attempts to separate the two activities from one another. Moreover, this ratio was nearly constant, whatever the source of the ferments. The purpurogallin number of the most active preparation from horse-radish was 900. The hæmatin content agreed with the figures of Elliott and Keilin[4]. Heavy metals other than iron were practically absent.

Determinations of the inhibitory effect of various reagents revealed remarkable differences between the dioximaleic acid and the purpurogallin tests. Hydrocyanic acid inhibits completely in the latter, incompletely and irregularly in the former. We think this irregularity, noticed first by Banga and Szent-Györgyi, must be connected with a strongly stimulating effect of hydrocyanic acid on the autoxidation of the dioximaleic acid with the subsequent formation of hydrogen of peroxides, which we have observed. Fluoride and azide inhibit in both tests though not to equal degrees, copper salts only in the dioximaleic acid test. Carbon monoxide inhibits only in the dioximaleic acid test. This inhibition is sensitive to light.

Heating ferment solutions to different temperatures caused qualitatively parallel inactivation in both tests.

The results mentioned indicated that the dioximaleic acid oxidase was a hæmin protein. Experiments with pure cytochrome *c* confirmed this conclusion[5]. We found previously[2] that cytochrome $c + 2\gamma$ of $Mn^{\cdot\cdot}$ were able to catalyse the oxidation of the dioximaleic acid.

We now find that manganese produces hydrogen peroxide by stimulating the autoxidation of the substrate. ($Fe^{\cdot\cdot}$-ions, but not $Cu^{\cdot\cdot}$, $Cr^{\cdot\cdot\cdot}$, $Ni^{\cdot\cdot}$ and $Co^{\cdot\cdot}$, stimulate the autoxidation, but practically no hydrogen peroxide remains in the solution, as it is removed by a secondary, peroxidatic reaction between $Fe^{\cdot\cdot\cdot}$, hydrogen peroxide and dioximaleic acid.) Thus the manganese can be entirely replaced by the addition of a small amount of hydrogen peroxide. The hydrogen peroxide, which does not disappear during the reaction, seems to take part as well in the reduction of the $Fe^{\cdot\cdot\cdot}$ as in the oxidation of the $Fe^{\cdot\cdot}$. Analogous mechanisms have been proposed for the catalase[6]. The cytochrome remains mainly reduced until all of the substrate is oxidized. Then the cytochrome is immediately oxidized and partly destroyed by the hydrogen peroxide. Manganese or hydrogen peroxide can be replaced by hydrocyanic acid, which stimulates the hydrogen peroxide production and does not inhibit the reaction because cytochrome *c* gives no compounds with hydrocyanic acid at this *p*H. We have here interesting examples of hydrogen peroxide maintaining, or hydrocyanic acid stimulating, a hæmin protein catalysis.

On the basis of the experiments described above, the possibility was considered that the natural dioximaleic and oxidase could be identical with the peroxidase. However, its manner of reaction in the dioximaleic acid and in the purpurogallin test might be different. In the latter the peroxidase is supposed to remain all the time in its ferric state[3]. In the former, on the contrary, we were able to demonstrate the reduction of the ferric to the ferrous state. If solutions of peroxidase preparations plus dioximaleic acid are shaken with air the colour turns from brown to red with absorption bands appearing at 580 and 545 mμ, belonging to the $Fe^{\cdot\cdot\cdot}$-hydrogen peroxide-peroxidase II[3] or to a hypothetical $Fe^{\cdot\cdot}$-oxygen-peroxidase, or to a mixture of both. If the air is rapidly replaced by carbon monoxide the bands of the $Fe^{\cdot\cdot}$-carbon monoxide-peroxidase (578,543) appear. Thus a valency change, ferric $\rightleftarrows$ ferrous, is involved in the reaction of the ferment with dioximaleic acid, but not with hydrogen peroxide plus pyrogallol.

The differences found in the experiments with inhibitory substances thus may be explained, and there is no sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments. Our results give an example of a ferment, acting in a different manner with different substrates. They also show that the characterization of ferments exclusively on the basis of the effect of inhibitory reagents may lead to mistakes. Differences may be due to the substrates and not to the ferments themselves. Finally, the dioximaleic acid is remarkable because it allows the peroxidase to produce the necessary hydrogen peroxide spontaneously. A detailed report will be published elsewhere.

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Dec. 7.

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[4] Elliott and Keilin, *Proc. Roy. Soc.*, B, **114**, 210 (1934).

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Diurnal Rhythms in the Axolotl Larva and in Drosophila

DURING spring and summer of this year, I made some experiments with the intention of throwing light on the physiological mechanism of diurnal activity rhythms. An account of some of the main results follows. It is hoped to publish full details of the experiments at a later date.

The motor activity of axolotl larvæ was recorded by means of a simple actograph. The animals were kept in a shallow layer of water. Their activity caused movements of the water surface, which were recorded on a slowly moving smoked drum, by means of a float connected with a light lever.

The larvæ showed a pronounced diurnal rhythm, under normal conditions of alternating daylight and darkness, being more active at night. If the larvæ were put in continual darkness, the rhythm persisted. If, however, they were subjected to alternating illumination and darkness, so controlled that the illumination phase was made later and later by gradual stages, the rhythm could be reversed. The animals were then active during the real day (this was by now the dark phase) and quiet at night (the artifically lighted phase). Evidently, the rhythm is primarily determined by light; but there is also an inherent rhythm revealed by the persistence of activity cycles in continual darkness.

I was unable to detect any diurnal activity rhythm in metamorphosed individuals.

Hypophysectomized larvæ are active by night and quiet by day, like normal ones; but only so long as the normal illumination cycle acts upon them. In continual darkness, the distribution in time of their activity at once becomes quite irregular. Thyroidectomy does not interfere with the activity rhythm. It appears then that the hypophysis plays an important part in the inherent rhythm revealed by normal animals kept in darkness.

The interrelations of internal and external factors in determining diurnal rhythms were also studied in Drosophila. Here a 'hatching rhythm' appears. Under normal lighting conditions, most of the adult flies emerge from the pupa in the hours just before sunrise. The interval between consecutive 'emergence peaks' is always twenty-four hours, whatever the temperature, and it appears that light is the primary controlling factor. If the culture is transferred to continual darkness, the rhythm continues unmodified at medium temperatures. At low temperatures the intervals are slightly lengthened, at high temperatures shortened.

By altering the temperature, the intervals between emergence peaks were varied between 2½ days and 16 hours. The 'inherent rhythm' revealed by the persistence of emergence maxima in darkness is therefore sensitive to temperature. It appears to have a temperature coefficient obeying van't Hoff's rule.

If a culture is kept from the first in continual darkness, no hatching rhythm appears. The rate of emergence is affected by temperature; less flies than usual emerge during and just after a rise, and more during and after a fall. However, temperature change does not induce a persisting rhythm. Light, on the other hand, can induce such a rhythm. One single illumination period, provided that it lasts for at least 4 hours, induces a 24-hours rhythm in a culture kept beforehand and afterwards in continual darkness. The temperature relations of the rhythm thus induced are as follows: (1) whatever the temperature at the time of illumination, the rhythm has a period of 24 hours, provided that the temperature does not afterwards change; (2) subsequent change has the usual effect (lower temperature slows, while higher temperature hastens, the rhythm). The fact that a 24-hour rhythm can be induced by a single illumination period, independently of temperature, is remarkable and the nature of the factors ensuring that the induced rhythm shall have a period of 24 hours remains, for the present, obscure.

The experiments were carried out in the Department of Zoology, University College, London. I wish to thank Prof. D. M. S. Watson for kindly allowing me to work in his Department, Mr. C. P. Wells for much helpfulness, and Mr. N. H. Howes for allowing me to use his intact and operated axolotls.

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Points from Foregoing Letters

REGENERATED cellulose sheet is shown by D. G. Drummond to be birefringent in a way which might reasonably be expected from extrapolation of Spence's results for sheets made from cellulose esters. The relative unimportance of side-chain orientation in cellulose itself results in a generally greater birefringence and a change in the 'slow ray direction' as compared with the ester films. Numerical results for regenerated cellulose sheets are given.

A. Schallamach finds that the heat conductivity of commercial rubber at the temperature of liquid air is about one fortieth of that at room temperature.

S. E. Williams has examined the absorption of the hydrogen line at 1215·7 A. in nitrogen, water vapour, oxygen and air. Nitrogen is transparent and water vapour absorbs very strongly. Oxygen and air absorb much more strongly than has previously been believed. No absorption appears to occur until the partial pressure of oxygen is about 0·04 mm., and the absorption coefficient varies in the lower part of the absorption range. If the emission of 1215·7 is responsible for short-wave fadeouts, the radiation will penetrate to about 80 km. before it is absorbed in producing ionization.

Making the assumption that the field responsible for the interaction between elementary nuclear particles is a two-particle field, so that a mesotron is always emitted or absorbed in conjunction with a neutrino or antineutrino, P. L. Kapur states that it is possible to derive the forces between the particles and to explain the phenomenon of β-disintegration.

That the three theories (1) the universe expands, (2) c decreases, (3) atomic frequencies speed up, are all equivalent and must not be looked upon as alternative explanations is stressed by K. R. Popper. The systems of measurements underlying these theories are compared and an observational approach to Milne's 'dynamical' time is mentioned. It is asked whether in (2) and (3), luminosities do not decrease with time (measured in frequencies) instead of distance.

Now that it is admitted that Sinanthropus is but a variant of the Pithecanthropus type, W. E. Le Gros Clark suggests that the generic term Sinanthropus should be discarded. The Peking fossils should be referred to the species *Pithecanthropus erectus*, or at the most they might be conceded a specific distinction with the name *Pithecanthropus pekinensis*. The argument that the femora ascribed to Pithecanthropus of Java do not really belong to this genus has no logical basis.

F. A. Squire states that, owing to geological peculiarities, the soils of the Virgin Islands are composed largely of flags. This makes stone terracing a practical, inexpensive proposition.

B. Swedin and H. Theorell have extracted and investigated the ferment recently described as new and called dioximaleic acid oxidase by Banga and Szent-Györgyi. From their observations, Swedin and Theorell conclude that this ferment is a hæmin protein and that it can act in a different manner with different substrates. They finally conclude that there is not sufficient reason for the assumption that the dioximaleic acid oxidase and the peroxidase are different ferments.

H. Kalmus describes experiments on the physiology of diurnal rhythms in axolotl larvæ and Drosophila, dealing with the relation between externally and internally determined rhythms, the action of light, temperature and endocrine factors.

RESEARCH ITEMS

Australian Shell Ornaments

A DETAILED study of shell ornaments in use by the aborigines over wide areas in Australia has been made by C. P. Mountford and Alison Harvey, ethnologists of the South Australian Museum (*Records S. Austral. Mus.*, **6**, 2, 1939). These shell ornaments fall into two divisions, one made from the baler shell (*Mela diadema*) and the second from the shell of the pearl oyster (*Meleagrina maxima*) and the smaller pearl shell (*Meleagrina margaritifera*). The pearl shell ornaments are found almost exclusively in western Australia, while with a few exceptions the baler shell ornament is limited to Queensland, Western Central Australia and north-eastern South Australia. The pearl shell ornaments are used for decoration and as objects of ceremonial importance. For the former purpose they are suspended from a belt back and front, while both men and women wear several down the back suspended from a necklace of human hair. In Central Australia the chief aspect of their magical purpose is their potence in charms for women and their healing properties. Various myths are woven round the pearl shell, and a particular chant is sung when the designs, which appear on them, are being engraved. The ornaments are oval in shape and vary from two to eight inches in length. The baler shell ornaments vary in use according to locality; but they may be used as ornaments or for ceremonial purposes. In west-central Queensland, for example, they are used for personal adornment or as a decoration on the haft of a spear-thrower. Among the Dieri, however, the shell ornament had great magical value and was closely connected with the circumcision ceremony, in which it was worn by the initiate as a chest ornament. The Dieri were also the only tribe using the shell for evil magic. In appearance the ornament was an ovate piece of white shell from two and a half inches to five inches long. Designs were engraved on the concave face and red ochre rubbed in. These shell ornaments were intended for male use only, but in certain circumstances, more or less ceremonial, women were allowed to handle or use them.

Scaphocephaly among Australian Aborigines

IN an examination of 2,000 skulls of Australian aborigines, Frank J. Fenner, honorary craniologist of the South Australian Museum, has found five cases of scaphocephaly (*Records S. Austral. Mus.*, **6**, 2; 1939). Two forms of scaphocephaly are recognized, of which one is descriptive of the form of skull characteristic of the Eskimo, and found among the Australian aborigines, and the second is pathological —a premature, probably fœtal, synostosis of the sagittal suture present in a very long narrow type of skull; this is a rare condition occurring in many races, European, Egyptian, Negroes, etc. The specimens here described belong to the second class. Premature closure may, of course, occur without any trace of scaphocephaly. Of the skulls examined three were adult (male) and two juvenile, 4–5 years and 6 years. Detailed observations and comparisons with such normal material as was available were made. In the result these observations would go to support the conclusion of Hamy that scaphocephaly is the result of the synostosis of the two parietal bones, that this synostosis is the result of a pathological process, probably inflammatory, and that the deformation occurs only when the fusion begins during intrauterine life at a time close to the commencement of the ossification of the cranial vault. In two of the skulls and in one described in 1867, fine vascular pores covering the surface of the bone gave evidence of a pathological condition. Three of the skulls examined showed a synostosis of the squamous suture, but of 1,200 normal aboriginal skulls, three only showed fusion of the squamous suture—all aged individuals. Probably this condition is here related to the sagittal synostosis and an outcome of the same underlying pathological cause.

Doubling the Chromosomes of Nicotiana

H. E. Warmke and A. F. Blakeslee (*J. Hered.*, **30**, 419–432; 1939) have successfully induced the doubling of chromosome numbers in *N. Sanderæ*, *N. Tabaccum* × *glutinosa*, and *N. glutinosa* × *N. sylvestris*, by treating with colchicine. Treatment of seed gave as high as 100 per cent tetraploids of *N. Sanderæ*. A new method of application by using an emulsion spray, consisting of stearic acid, morpholine and lanolin, has been found more efficacious than the water spray. It is noteworthy that mixtures of fertile and sterile flowers on one plant were not obtained from seed treatment, but the whole plant was either diploid or tetraploid in behaviour. On the other hand, stomatal size in these plants was not always correlated with fertility. This indicates that some of the plants may have been periclinal chimæras.

The Chrysanthemum Midge

A MINUTE, red, two-winged fly which produces small conical galls upon the leaves and stems of chrysanthemums has been recognized as a serious pest in the United States, and has appeared twice in Great Britain during the last decade. The present attack is, fortunately, somewhat limited, but Dr. H. F. Barnes has published a timely description of his studies of the insect (*J. Roy. Hort. Soc.*, **64**, Pt. 2; Nov. 1939). The midge, which has usually been recorded as *Diarthronomyia hypogœa*, infests commercial late-flowering chrysanthemums, but will not apparently spread to the earlier summer kinds, nor to common, closely related weeds. Five generations appear every year in cool greenhouses, but in heated structures there are eight. The length of time spent in each stage of the life-history appears to depend directly upon temperature, being generally shortened by summer heat. Severely infected plants do not flower. Consistent spraying or fumigation with nicotine provides a complete, though very expensive, control. The most effective prevention, however, is the cutting of infected shoots to ground-level, for the stool cuttings which emerge later from such plants are found to be free from the insects.

Larvæ of British Coleoptera

IN the *Entomologists' Monthly Magazine* of November and December, Dr. F. van Emden, of the Imperial Institute of Entomology, contributes the first of a series of articles on the larvæ of British Coleoptera (beetles). The object of these contributions is to provide keys to enable the larvæ of the

British members of the order to be recognized as reliably as possible, and the first of these articles deals with the family Cerambycidæ. The material upon which the account is based consists primarily of that available in the collections of the British Museum (Natural History). Important additions, however, were based upon the specimens obtained on loan from the Zoological Museum, Copenhagen. All the thirty-six genera of British Cerambycidæ are included in these keys. Seven of the genera, however, have their characters taken from literature, since no larval material was available. While it will obviously be a lengthy business in dealing with the larvæ of even the chief families of British Coleoptera, the present account is a good beginning, and we hope to see many other groups similarly treated by Dr. van Emden.

Control of the Bean Rust Fungus

A RUST disease of the bean is widely distributed in Lower and Middle Egypt, and its control has formed the subject of a study by Dr. A. F. El-Helaly (*Min. Agric. Egypt, Tech. and Sci. Serv. Bull.* 236, Govt. Press, Bulâq, Cairo, P.T. 4, 1939). Spraying with Bordeaux mixture of half per cent strength was found most effective, and yielded the significant net profit of from one to four Egyptian pounds per feddan. Chocolate spot, caused by *Botrytis fabæ*, was also controlled by the same treatment. Sulphur fungicides were tried, but were not found reliable against these particular parasites, and the Bordeaux treatment possessed the further advantage that no physiological check was administered to the foliage.

Vertical Air Currents

SCIENTIFIC Note No. 81 (7) of the India Meteorological Department, by K. P. Ramakrishnan, deals with vertical currents in the first few kilometres over Poona and their possible effect on the measures of upper winds made by pilot balloons assumed to rise at a known constant rate. The vertical currents were deduced from the height-time curves found for balloons by the tail method, which involves measurements of the angle subtended by a tail assumed to hang vertically beneath the balloon, with the aid of a special graticule in the pilot balloon theodolite. The method is probably accurate enough for the purpose of revealing vertical currents of the strength of those often observed at Poona in the hot season. A more serious source of error in computing the vertical currents arose from the assumption that the differences between the observed rate of ascent (V) and the rates given by the standard formula $V = q\frac{L^{1/2}}{(L+W)^{1/3}}$, where q is a constant for a particular size of balloon, L is free lift and W is weight of balloon, are measures of the vertical currents. Actually, the rate of ascent of a balloon is affected by its shape, which is never truly spherical, and, to judge from the performance of the 100-gm. Dewey and Almy balloon, by other factors not yet understood, for with this balloon, so far as observations have been made at the Meteorological Office, the rate of ascent varies roughly as $\frac{L}{(L+W)^{2/3}}$, and not as the square root of that quantity, as is implied by the standard formula. Such sources of error probably do not invalidate two of the conclusions reached by Ramakrishnan; first, that the rate of ascent of a balloon for a given lift and weight is far more variable in the afternoon than in the morning at Poona, and that this is due to the greater magnitude of the vertical currents in the afternoon, and secondly that a method of obtaining upper winds that involves the assumption of a constant rate of ascent of the balloon is thoroughly unreliable in a tropical climate like that of India. The values of vertical velocity found were mostly between 3 km. and 5 km./hour in the afternoon, and occasionally reached 10 km./hour.

Geography of Egypt

A VOLUME entitled "Contributions to the Geography of Egypt", written by J. Ball (Cairo: Government Press. 10*s*. 6*d*.), may be regarded as a comprehensive study of most aspects of the Nile and contains a great deal of new matter as well as facts that are scattered in various publications. Apart from the treatment of the physical aspects of the Nile basin and water, the Faiyum depression is the subject of a lengthy study. Much has already been written on this lake. Dr. Ball points out that the absence of Pliocene deposits proves that the depression cannot have been in existence in those times. The numerous lacustrine deposits of later ages show that a lake of varying height must have existed from early Pleistocene times to the present day, and since there can have been no erosional deepening of the depression while the lowest part was below the surface-level of the lake, its excavation must have been entirely accomplished between the end of the Pliocene and the beginning of the Pleistocene. But the Nile then flowed at much higher levels than to-day, so that its lateral stream could not have effected erosive action at such low levels. Thus, argues Dr. Ball, the Faiyum was hollowed out independently of the action of the Nile: some other agency must have been at work. He concludes that the depression is due to wind erosion in early Pleistocene times, and this theory is supported by what is known of the origin of other depressions in the Libyan plateau such as the oases of Kharga, Dakhla and Qattara.

Drainage of Southern Ireland

THE peculiar trellised pattern of the river system of southern Ireland has attracted considerable attention since Jukes postulated a superimposed origin from an elevated initial surface. Hull modified this hypothesis by invoking fault lines as controlling the right-angled deflections of the rivers. Austin Miller has re-examined the whole problem in a paper entitled "River Development in Southern Ireland" (*Proc. Roy. Irish Acad.*, **45**, Section B, No. 14). One of the most difficult features to explain is the failure of the subsequent at the expense of the consequent rivers in the completion of the pattern which might be expected to have led to the outflow of the Blackwater to Dungarvan Bay and the Lee to Youghal Bay. Conditions appear to favour this completion, for there has been rejuvenation since the present mouths were acquired that would provide the subsequents entering these two bays with the increase in gradient necessary for headward encroachment. Mr. Miller suggests that the explanation lies in the acquisition by the present estuaries of a volume of discharge, by a long process of captures, so much greater than that of their competitors that they have been able to excavate sufficiently rapidly through the hard ridges that attempt to bar their courses and so outrival the strike streams in spite of the softer rock over which the latter flow.

AIR TRANSPORT, INSECTS AND DISEASE

BY DR. A. D. IMMS, F.R.S.

MR. F. G. SAREL WHITFIELD has recently issued a comprehensive article on air transport, insects and disease (*Bull. Entomol. Res.*, 30, 365–442; 1939). The discovery by Shannon in 1930 of the presence of *Anopheles gambiœ*, an insect native to Africa, in the city of Natal, Brazil, and its subsequent spread, directed special attention to the carriage of disease-bearing insects by aeroplanes. Whether *A. gambiœ* was actually transported in a surface vessel or in an aircraft will probably never be known, but, as the result of its entry and subsequent spread, more than 90 per cent of the population around Natal were infected with malaria in 1938. The indexes of malaria-infected mosquitoes are said to be the highest in the history of malaria. The introduction of *A. gambiœ* into South America seems to have had the disquieting results, just referred to, because possibly the native population has very little power of resistance to the African strain of the disease carried by the mosquito.

The situation as regards yellow fever is potentially far more serious than that concerning malaria. Shannon, Whitman and Franca in 1938 made a significant contribution to what is known of the vectors of yellow fever. They produced positive evidence of the mosquitoes *Aëdes leucocelœnus* and *Hœmogogus capricorni* being concerned in the transmission of jungle yellow fever in Brazil. Until this discovery, evidence of any mosquito other than *Aëdes œgypti* being implicated in the transmission of yellow fever was furnished solely on the results of laboratory experimentation. The aspect of most importance with regard to aerial transport, arising out of recent research on yellow fever epidemiology, seems to be the discovery of vast areas in Africa and South America where the disease prevails in epidemic or endemic form. It is obviously of prime importance that aircraft operating within and from Africa and South America should be maintained free from all insects. Mr. Whitfield points out that the proposed reserve Empire war route across Africa to India and Australia will present an urgent problem in this connexion, and that it would be unwise to inaugurate such a service until the proper control of insects in aircraft has been achieved. In view also of the proved existence of considerable insect populations in the upper air, the question of the possibility of aircraft collecting insects while in flight arises. The ability of insects to survive air transit is another problem. *Aëdes œgypti*, for example, has been proved to be able to endure a journey of at least 9,580 miles in length and of 6½ days duration.

Diptera are overwhelmingly the commonest insects found in aircraft. Species of Musca are very frequent and also many kinds of mosquitoes. The control of insects in aircraft is a difficult subject. As Mr. Whitfield remarks, it involves the co-operation of the entomologist, the chemist and the engineer, an airline operating company and a commercial aircraft manufacturer. Such joint approach to the problem, he holds, is essential if progress is to be made. No adequate and reliable method of control of insects in aircraft has yet been devised: the problem of controlling insect invaders of aerodromes needs also the fullest attention. Little will be gained, the author adds, from further research upon insects found in aircraft—the real problem being the effective means for their destruction.

THE ROTHAMSTED EXPERIMENTAL STATION

BY E. J. ROBERTS

THE annual reports of the Rothamsted Experimental Station are of more than ordinary interest to farmers and research workers. The amount and variety of the fundamental investigations carried out in the laboratories, linked with the field work not only at the Rothamsted and Woburn farms, but also at a number of commercial farms scattered over England, give these reports a character and importance of their own. The improvements in the technique of field experimentation, evolved at the statistical department, have not only given more accuracy to the usual trials, but also have widened the scope of investigations by making it possible to detect small differences, and to measure, for example, the interaction effects of certain manures.

In the report for 1938*, published recently, an account is given of the experiments on wheat, including those on the continuous growing of this crop, and those on the value of leys, green manures, and fallows for preceding the wheat crop. The experiment on the continuous growing of wheat has now been in progress for nearly a hundred years, and it is interesting to note that the land has not become what might be termed 'wheat-sick'; the main difficulty has been in the suppression of weeds rather than in the actual growth of wheat. This conclusion is important at the present time. Why, it is asked, when these experiments prove clearly that wheat can be grown continuously on the same land, should difficulties arise when the crop is grown for a few years in succession on certain mechanized farms? An explanation is offered to the effect that the nature of the soil is responsible. Wheat is a heavy-land crop, and, on the heavy Broadbalk soil, the crop remains healthy; diseases and pests are present; but they do little damage. The lighter soils, however, especially the light chalky soils on which many mechanized farms are situated, are more liable to contain diseases, such as take-all, lodging diseases and others, and the crop suffers more heavily.

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* Rothamsted Experimental Station, Harpenden. Report for 1938. (Harpenden: Lawes Agricultural Trust.) 5*s*.

The effects of temporary leys, green manures, and fallows as preparation for wheat are also under investigation, and the field trials are combined with work in the chemistry department to follow seasonal changes in nitrates, ammonia, and readily decomposed crop residues in the soil; an attempt is made to trace the form in which available nitrogen is carried over from one year to another.

Sugar beet is the subject of extensive investigations carried out on a variety of soils, in conjunction with the sugar factories; the extent of these experiments may be judged from the fact that, in 1938, there were 38 experiments, with 1,360 plots. These experiments are mainly concerned with manurial responses in the various soil groups. The year 1938 was disappointing as regards this crop, the yield, expressed in terms of sugar, having been 12·5 cwt. per acre less than the average of the previous four years.

Other long-term experiments recorded are those on organic manuring by means of green crops, town refuse and straw. The question of organic manuring, and of the use of town refuse in particular, is of more than ordinary interest to-day. It is interesting to note that a prepared town refuse gave encouraging results in a comparison with sulphate of ammonia, dung and rape dust. The refuse gave rather higher yields than farmyard manure providing equal nitrogen in three out of four comparisons, and did almost as well as sulphate of ammonia providing half as much nitrogen.

Other sections of the report also contain much of interest, for example, those on the farm, and the report on fungus diseases at Rothamsted and at Woburn. Details are given of the experiments at outside centres. It is interesting to observe that in such experiments, which are designed at the Station, the degree of precision compares favourably with that in the experiments carried out at Rothamsted and Woburn.

ELECTRICITY SUPPLY IN AUSTRALIA AND NEW ZEALAND

THE rapid expansion in the practical applications of electricity in parts of Australia and New Zealand and the new problems to which it gives rise is well illustrated in the *Electrical Times* of November 23. In England we consider a 'County Council' as a body which has definite connexions with general public services as, for example, health, education, highways and the like. This is not the case at Sydney, New South Wales, where the 'Sydney County Council' was created in 1935, by a special Gas and Electricity Act, which enables it to assume ownership and control of the electricity department which up to that time had been in the hands of the City Municipal Council. This County Council has only five members, two of them elected by the City Municipal Council and the remaining three being shared by the municipal councils of thirty-two other townships. For election as a councillor, the candidate must be qualified by being eligible for aldermanship in one of these constituencies. This arrangement has points of similarity with that of our own Joint Electricity Authorities (J.E.A.). The Sydney County Council supplies electricity directly to the public in the city, thirty-two suburbs and for street lighting in the city. In addition it gives a bulk supply to fourteen other municipal authorities who do their own distribution, and to a company which distributes to two other municipal areas. The area throughout which a direct supply is given is about 150 sq. miles and its population is about 900,000. The 'bulk' areas are about 750 square miles and have about 150,000 inhabitants. Altogether the County Council supplies electricity over an area of approximately 900 sq. miles and having more than a million inhabitants.

The County Council co-operates with the railway department, which has a supply station of its own so as to level the output and so cheapen the cost. The interchange of energy between them is adjusted so as to be nearly equal at the end of each quarter. The main business of the County Council's Electricity Sales Branch is three-fold: first, to develop and advertise the use of electricity in commerce, industry and the home, secondly to sell electrical apparatus and thirdly to deal with contracts for large supplies of energy. The sale of apparatus, ranges, water-heating systems and wash-boilers is arranged for cash or on hire purchase. Instantaneous heaters are sold for cash only. The installation work is also sold by the Council. Two forms of merchandizing are employed. In one the Council buys the equipment and sells it to the consumer. In the other the Council sells the apparatus for the supplier on a commission basis. The basis of the Council's service policy is "make friends with the consumers. This is effected by the advisory service, which not only develops the use of electricity but keeps the consumers satisfied".

Reports from the New Zealand municipalities, which largely utilize hydro-electric power, show that there is considerable anxiety in both North and South Islands as to how to meet the coming winter loads. Deputations have approached the Government and pointed out the limitations of the hydro-electric power available and the urgent need of steam-driven plant to cope with the expected peak load of 1941. The general manager of Christchurch Electricity Department ends his report with these words: "The city of Christchurch is now so completely dependent upon electricity supply in its public services, which include sewerage and water pumping, that the electricity supply intimately concerns hygiene and health as well as the general public life". It looks as if in a few years' time these words would apply to many cities spread over the whole world.

The electrical engineer of Dunedin says that they cannot always count on getting the same ample supply of water-power every year. In severe frosts in winter time very little water-power may be available. The great demand for instantaneous water heaters for baths shifts the maximum load from the afternoon to the early morning. This makes it difficult to devise an equitable multi-tariff meter system which will charge the consumer most at times when the load is a maximum at the supply station.

PALÆOLITHIC MAN IN THE NORTH MIDLANDS

NOW that the text of Mr. A. Leslie Armstrong's Wilde Memorial Lecture is available in full (*Mem. and Proc. Manchester Lit. and Phil. Soc.* 1938–39, 83, 1939. Separate, pp. 30, with plates. Price 1*s*.), the results of the investigations summarized in that lecture call for more extended notice than was possible at the time of its delivery on March 14 last (see NATURE, **143**, 512 ; 1939). As Mr. Armstrong pointed out, the North Midland area, that is, the Trent basin north of Leicester, has yielded evidence which now makes it possible to demonstrate on a stratigraphic showing the presence of man here during every stage of the palæolithic period more completely than for any other part of England.

An important consideration, which Mr. Armstrong emphasized in the opening of his lecture, was the constant oscillation in climatic and environmental conditions during the Ice Age, while at the same time he dwelt on the distinction worked out in detail by the Abbé Breuil between the core culture peoples associated with inter-glacial periods and the flake culture races associated with glacial periods. The changing environment not only brought about racial movement, but also necessitated cultural development and the elaboration of new types of implements, although with the setting in of less favourable conditions once more old and traditional types at times were revived.

Mr. Armstrong's evidence was drawn in part from recent explorations of the Trent Valley gravels, still in progress, in part from his now well-known investigations in Yorkshire and Derbyshire caves and on certain sites in Lincolnshire.

LOWER PALÆOLITHIC AGE

The first record of Lower Palæolithic implements in the Trent Valley was made in 1928 in a gravel pit at Burton. Further investigation by Mr. Armstrong and others has now shown that all the recognized forms of both the core and the flake industries from Pre-Chellean to Mousterian occur here. These finds come from three horizons of gravel, comprising two old river-terraces and a high-level glacial gravel. The main interest of the investigation, therefore, lies not merely in the occurrence of this range of types here, but also in the correlations which it has made it possible to attempt.

Recent investigation has also determined that the gravels, though they have been described as "Old Valley Gravels", are actually of sub-glacial origin. The low terrace comprises the infilling of an ancient valley of which the floor lies far beneath the bed of the Trent and through which that river has cut its channel. The most important deposits of the series are the high-level gravels, which mantle extensive areas on both sides of the valley. In the deposits three zones are distinguished, of which A, the oldest, in certain of the Hilton sections, rests upon bed-rock, the Keuper marl, while in others it thins out until B rests on that rock. In other sections B and C zones, separated by a band of sand in gravel particles, alone are present.

As regards archæological content, artefacts found in Zone A *in situ* fall into two well-defined groups, of which the first, consisting of pre-Chellean, Chellean and a Levallois flake are patinated a deep chocolate-brown, heavily rolled and evidently derived from an earlier deposit ; while the second is patinated bluish-white and appears to be contemporary with the gravel. In the latter group were a typical Acheulean hand-axe, as well as a late Clactonian (or Tayacian) flake and two slightly rolled Levalloisian flake tools. The contents of Zone B, though less numerous, are the same as in A, but differ materially in condition. All are heavily rolled, but some Levallois and Clacton types are only slightly abraded. The patination suggests that the abraded artefacts are derived from Zone A.

Zone C exhibits extreme contortion, suggesting lateral pressure, or collapse under the influence of melting snow and ice. It has not yielded any Acheulean types, but two heavily rolled Clactonian and a Levalloisian flake, both only slightly abraded and, therefore, possibly contemporary with the gravels, have been found. The latter are important for correlation purposes.

For these conditions certain tentative interpretations are put forward by Mr. Armstrong. In the first place, he suggests that the co-existence here of core and flake may be due to the fact that they are not, as concluded by the Abbé Breuil, two distinctive cultures, but two techniques ; and in that event, while the flake industry was indeed almost exclusively employed by the ancestral Mousterian race, Acheulean and later peoples may have employed Clactonian and Levalloisian techniques where necessary or expedient. Secondly, that Zone A represents a deposit laid down at the end of the great Acheulean inter-glacial—possibly a remnant of the Little Eastern glaciation equated with Würm—which has been ploughed away and incorporated in Zone B. Thirdly, that Zones A and B respectively correspond with the two glacial phases separated by an interglacial phase, associated with a Mousterian (Late Clactonian or Tayacian or Micocquean in its earlier phase) observed in the Pin Hole section, Cresswell Crags. Fourthly, Zone C may be either a melt-out of Zone B, or a local re-advance of the ice after the B stage, or the final glaciation (Hessle) of the northern region.

MIDDLE PALÆOLITHIC AGE

In dealing with the Middle Palæolithic Age, Mr. Armstrong's evidence is chosen entirely from the cave explorations on which he has been engaged with the assistance of a Research Committee of the British Association for more than thirteen years. The Pin Hole Cave, Cresswell, has given a type cave section for Britain with occupation ranging from Mousterian I to the developed Aurignacian of the Upper Palæolithic which is preserved as an 'ancient monument'. The deposits consist of two beds of cave earth, of which the lower and earlier extends from Early Mousterian to the proto-Solutrean which with Aurignacian appears in the base of the upper bed.

As already mentioned, the lower deposit affords evidence of two glacial phases with a warm inter-glacial. If indeed these levels are correctly correlated with the Little Eastern glaciation and thus with Würm, this interglacial affords evidence of a North Midland retreat of the ice in relation to the Little Eastern which has not previously been recorded.

UPPER PALÆOLITHIC AGE

The highly significant evidence for the Upper Palæolithic period, drawn in part from cave deposits, in part from north Lincolnshire open sites, must here be dismissed in brief. Among the more interesting conclusions to which excavation has led, is the confirmation of the absence of any gap in continuity between Upper Palæolithic and Mesolithic, and at the close of the Aurignacian period the remarkable local variability in type of the elements of the culture. Two finds which must not be passed over are a fragment of mother-of-pearl skilfully shaped, possibly part of an amulet, and a cowrie shell. *Cyprea moneta*, from the Pin Hole Cave.

HEARING TESTS

IN the December number of the *Bell Laboratories Record,* Mr. H. C. Montgomery, of the Acoustical Research Department of the Bell Laboratories, discusses results obtained by subjecting many of the visitors at the World's Fairs to tests of the quality of their hearing. The records obtained enabled him to get nearly three-quarters of a million of records carried out in the same way.

The Bell system deals in hearing, and to get the best service it is important that it have available trustworthy data on the hearing characteristics of the American people. The tests are given in soundproof rooms arranged to seat seven visitors, each partially screened from the others. Both the tests and the instructions are given through telephone receivers; the visitor holds the receiver to his ear with one hand whilst he marks the results on a card with the other. Two types of tests are given, with separate booths for each. In one the visitor hears spoken words, which are two numbers, such as "eight-six". The numbers heard are written on the card, and each successive pair is at a lower volume. Twelve pairs of numerals are spoken at successively lower volumes; and then the test is repeated with a different series. In the other type of test, the two numbers are replaced by pure musical tones, each tone being sounded from one to three times, and the listeners write down the number of times they hear the tone. Five tests, each consisting of nine sets of tones at successively lower volumes, are given. The first is a moderately low pitch, 440 cycles per second, which corresponds to *A* above middle *C* on the piano. Each following test is one octave higher in pitch and thus the hearing is tested at 440, 880, 1,760, 3,520 and 7,040 cycles.

At the San Francisco Exposition were three booths, one arranged for word tests, one for tone tests, and one that could be used for either. At New York eight booths were provided for each type of test. Only the tone tests were recorded. The word tests give only a check on one's ability to understand spoken words, while the tone test, by providing data at five frequencies over the most important part of the aural range, is more suitable for study and analysis. Before a record is made on the test card the attendant puts a mark on it to indicate whether the visitor is male or female, coloured or white, and to which of the five age groups the person belongs, the age groups extending in five groups between 10 and 60. The cards are then run through a Recordak machine which analyses the curves marked on them. The cards are then run through tabulating machines which analyse and sum up the data. The results of this survey indicate a definite falling in hearing acuity with age. This is in harmony with previous data, which indicate a definite falling off in hearing acuity with age, particularly noticeable at the higher frequencies. A rather remarkable fact is that at the low frequencies the falling off with age is less for men than for women, while at the higher frequencies it is less for women than for men. In the lowest age group the difference between men and women is small, but even here the advantage is slightly with the men at low frequencies and with the women at high frequencies. In the age group 50–59 years the difference becomes much more pronounced.

The curves show that for young ears and low frequencies, the tests are grouped fairly closely around the average. For older persons or higher frequencies, the distribution spreads and the number with average hearing becomes small; most differ from the average in both directions and in varying degrees. The interpretation of the losses at various frequencies needs a specialist, since the evaluation of the effect on one's ability to hear in any particular band of frequencies is a function of many factors. It has been found that one's ability to understand speech can be determined from the average of his hearing losses at 440, 880 and 1,760 cycles per second as compared with good young ears. If this average is 25 db. (decibels), there may be some difficulty in hearing in auditoriums and churches, while if it is 45 db. there may be difficulty in hearing in direct conversation. Only if the hearing loss is as much as 65 db. will there ordinarily be much difficulty in hearing over the telephone.

By use of these figures, the tests indicate that about one out of twenty-five persons have difficulty in hearing in auditoriums; one in 125 will have some difficulty in direct conversation; and one in 400 over the telephone. Two out of five men between 50 and 59 will have a loss of at least 25 db. at 3,520 cycles, while only one in five women will have as great a loss at this frequency. It was found also that about one in 25 of the group from 10 to 19 had a loss of at least 25 db. at 7,040 cycles. This figure is important, because it has been found that young people with a hearing loss of this amount will often be found to become progressively worse in later years, but if remedial measures are taken immediately, impairment may be largely checked. No significant difference was found between the visitors to the Fairs who were resident in New York and those resident in San Francisco. The time of day at which each test was taken was marked on the card and permits a comparison of the results for different periods of the day. No consistent difference was found between early morning and late afternoon. There is thus no indication of any effect being produced in the hearing by fatigue.

SEVENTY YEARS AGO

NATURE, vol. 1, January 13, 1870

Government Aid to Science

ALFRED RUSSEL WALLACE, in a letter to the Editor, writes: "The public mind seems now to be going mad on the subject of education; the Government is obliged to give way to the clamour, and men of science seem inclined to seize the opportunity to get, if possible, some share of the public money. . . .

"Now, sir, I protest most earnestly against the application of public money to any of the above specified purposes, as radically vicious in principle, and as being in the present state of society a positive wrong. . . . I uphold national education, but I object absolutely to all sectional or class education; . . . The broad principle I go upon is this,—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not directly available for the benefit of all. . . . If we follow this principle, national education is not forbidden, whether given in schools supported by the State, or in museums, or galleries, or gardens, fairly distributed over the whole kingdom, and so regulated as to be equally available for the instruction and amusement of all classes of the community. But here a line must be drawn. The schools, the museums, the galleries, the gardens, must all alike be *popular* (that is, adapted for and capable of being fully used and enjoyed by the people at large), and must be developed by means of public money to such an extent only as is needful for the highest attainable *popular* instruction and benefit. All beyond this should be left to private munificence, to societies, or to the classes benefited, to supply."

A New Thames Subway

THE importance of geological data on the extent of the London Clay was emphasized in an article by J. Prestwich, F.R.S., on the second Thames subway. "The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. . . . The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work. . . . The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down [the shafts]." The tunnel, 1320 feet long, was begun on April 26, and finished on October 8, 1869, without a single fatal or even serious accident to any of the men employed. It is no longer in use.

On the Periodicities of the Solar Spots

"Messrs. De la Rue, Stewart, and Loewy have for some time past been engaged in investigations [at Kew Observatory], which . . . go to show that there is an intimate and, as yet, unexplained connection between the configuration of the planets and the position and number of the spots on the sun. This result, which at once seems to land us in a sort of modern astrology . . . is . . . questioned by many European astronomers". Accordingly, a digest is given of independent investigations carried out by Dr. Kirkwood and published in the *Proceedings of the American Philosophical Society*. Among his conclusions were that the theory "has been placed beyond reasonable doubt", and the "11-year cycle of spot variation is mainly dependent on the influence of Mercury".

THE oxy-hydrogen light is now largely used in Paris for illuminated advertisements and theatrical purposes. Carts with metal reservoirs containing the compressed oxygen for the supply of customers may be seen in the streets. At the Gaieté Theatre, which is one of the largest consumers, cylinders of magnesia or zirconia take the place of the lime cylinders ordinarily used for this light.

PROF. HELMHOLTZ, of Heidelberg, has been elected a corresponding member of the Physical Section of the Paris Academy of Sciences.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

UNIVERSITY ASSISTANT IN BOTANY—The Secretary, The University, Aberdeen (January 20).

UNIVERSITY GRADUATE AS TEACHER OF ENGLISH for British-Peruvian Cultural Association, Lima—The British Council, 3 Hanover Street, W.1 (quoting 'Lima') (January 24).

LECTURER IN GEOGRAPHY in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (February 5).

LECTURER IN MECHANICAL ENGINEERING in the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, E.C.3.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 18: On a Recent Bog-Flow in Powerscourt Mountain Townland, Co. Wicklow. By A. D. Delap and G. F. Mitchell. Pp. 195–198. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [2712

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1929 to 1938 (Trade and Commerce Section). Sixty-eighth Number. (Cmd. 6140.) Pp. xv+234. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [2712

Royal Meteorological Society. Bibliography of Meteorological Literature. Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol. 4, No. 7 (January–June 1939.) Pp. 351–414. (London: Royal Meteorological Society.) 2*s*. 6*d*. [2712

Other Countries

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 231: The Incidence of Contagious Abortion in Domestic Animals in Egypt. By Dr. Mohamed Ragheb Ahmed. Pp. 29. P.T. 4. Bulletin No. 236: Further Studies on the Control of Bean Rust, with some Reference to the Prevention of Chocolate Spot of Beans. By A. F. El-Helaly. Pp. 24. P.T.4. (Cairo: Government Press.) [2712

Meddelanden från Oceanografiska Institutet i Göteborg. 2: The Radioactivity of Seawater. By Ernst Föyn, Berta Karlik, Hans Pettersson and Elisabeth Rona. Pp. 44. 3: Large-scale Plankton Cultures. By Hans Pettersson, Fabius Gross and Friedrich Koczy. Pp. 25. (Göteborg: Elanders Boktryckeri A.-B.) [2712

Carnegie Corporation of New York. Report of the President and of the Treasurer for the Year ended September 30, 1939. Pp. 168. (New York: Carnegie Corporation of New York.) [2812

Catalogues, etc.

Pocket Diary for 1940. (Bonnybridge: John G. Stein and Co., Ltd.)

Desk Engagement Pad for 1940. (London: W. Edwards and Co.)

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DIRECTION AND UTILIZATION OF RESEARCH

IT is not always realized that, when research in the laboratory has succeeded in producing a new article or product for manufacture, it is probable that a considerable amount of capital has to be spent—not only on plant, but also on overcoming engineering and chemical difficulties, and often in creating a demand for the product —before any return can be obtained. Under modern conditions one individual can rarely take all the steps required for the development of a new product—the research work, the design and running of the small-scale plant, the market investigations, the design of the full-scale plant, the building of the factory, the running of it, the management of labour, the control of output to meet the demand, the creation of demand, the actual selling and the finding of the capital to erect the plant and for trading. Most of these steps require specialists, and it could scarcely be expected that one man should have the knowledge to do them all well; if he had, it would be difficult for him to decide to which he should give his chief attention as the development proceeded.

Let us consider where and how research comes into the scheme of things. In the beginning, it is not usually obvious that a research reaching a successful conclusion is one suitable for development. Although a successful development may afterwards seem to have been very obvious, it was probably not so obvious at the time. There are always doubts as to the potentialities of the market, and even perhaps as to the availability of the raw materials at a cost which will leave a profit. A decision has to be made; a risk has to be taken. Hence the question of finance enters into the problem, for those responsible for finding the capital have to be persuaded that the risk is a reasonable one. This task is an important function of the 'director of research', and without him there are sure to be difficulties, misunderstandings, and perhaps in some cases recriminations. It is a matter of experience that the research worker who makes the discovery or devises the process is rarely the best person to win the necessary confidence of an administrative board.

It is of first-rate importance, therefore, to consider the qualifications of a successful director of research. First of all, he must be himself a scientific worker. He must understand the research workers' outlook; he must encourage their enthusiasms. On the other hand, he must have a keen appreciation of developments on which the administrative body is prepared to spend money. He must know as much as he can of all branches of the industry from manufacture to sales, or he will never be able to understand the outlook of the administrative board. His knowledge of science should enable him to have a broad idea of the lines on which the industry may be expected to develop, and he should continually keep the board and departmental managers informed of the lines on which he expects development to be made.

Although the director of research will not find much time for doing research himself, he must not allow administration to become his chief interest. He must believe in the scientific method of approach to a subject; he must be continually assisting in summarizing and relating the results of incompleted researches, and to do this he must have been a successful research worker himself. He should be a helpful critic of the researches of his staff.

While it may be conceded that an able director of research is needed in a commercial company to obtain the confidence of the administrative body for the development of scientific discoveries, it is not generally appreciated that directors of research of Government departments and research associations have similar tasks. There are now a considerable number of directors of research in Great Britain, and they have been an essential factor in the successes which science has achieved in industry and in the arts of peace and war. But the functions of these men are not generally understood by men of science, by Government departments, or by politicians, though these services are realized by many industrialists. Their services to science itself are rarely recognized, although some of them have been elected to the fellowship of the Royal Society before they became directors of research. It is generally impossible for the successful director of research to devote himself sufficiently to one subject, and in consequence this acknowledgment from the world of science rarely comes his way.

At the present time, when ministries and Government departments are being subjected to frequent scrutiny, it is opportune to recommend to them the inclusion of a director of research in their organizations. Some of the ministries have them, and probably would not be without them now. Others have scientific advisers who give advice when asked, but this is not what is required. Every ministry should have, as an integral part of its personnel, a director of research, in close touch with *all* its problems, whose principal duty would be to advise the ministry when the man of science can be helpful. The director of research would not, as a rule, attempt to give the scientific advice himself, but a small organization under his control would see that it was obtained from the best sources available, and, as further research would be needed in most cases, he would arrange for it to be done. The Ministry of Food should certainly have a director of research, and the Ministry of Agriculture too; he would enable these ministries to make fuller use of the Agricultural Research Council, and the Medical Research Council, as well as other research workers. Another department which might well have a director of research is the Board of Trade, to enable the Board to make use of the potentialities of the Department of Scientific and Industrial Research. Appointments such as these would add relatively little to the budgets of the departments concerned, but would go a long way towards ensuring efficiency in the utilization of the scientific resources of Great Britain.

DESIGN IN NATIONAL LIFE

The Shape of Things

An Introduction to Design in Everyday Life. By Noel Carrington. Pp. xv+209. (London: Ivor Nicholson and Watson, Ltd., 1939.) 6*s*. net.

A SUGGESTIVE chapter in Bavink's "Anatomy of Modern Science" is devoted to a discussion of the technological ideal of fitness for a purpose. Over an increasingly wide sphere of life we are becoming aware to-day that the squalor, ugliness and lack of beauty in our surroundings are due at least in part to the neglect of this principle. The deplorable position of the Special Areas can be directly attributed, as the successive reports of the commissioners for those areas show, to our lack of design in the planning of industry. The acuteness of the problems in the government of London can be traced to a like cause, and chaos in transport, ribbon building and the destruction of amenities have a similar origin in the absence of any comprehensive design sufficient to compel planning and control on an adequate scale.

It is not only in such matters that we have failed to utilize the possibilities which new materials and new means, put at our disposal by science, have afforded. In the smallest things of everyday life, the use of such materials or forces is apt to be determined less by their intrinsic qualities than by the traditional forms in which the materials they are superseding or displacing have found expression. Outstanding examples are to be found in the tardiness with which the motor-car has freed itself from forms imposed by the tradition of the horse-drawn vehicle, and the resistance of the building industry to the adoption of new forms and possibilities inherent in the steel framework or the new plastics.

Resistance or delay of this type is, however, not due entirely to the conservatism of the manufacturer. It is also partly due to the absence of a public awake to the possibilities and sufficiently alive to the fundamental principles of design to demand appropriate forms of expression for the new means and materials.

Mr. Carrington's little book has the great merit of giving in a very brief compass a comprehensive picture of the incidence of design in everyday life, from the ordinary utensils of house or office, houses, streets and vehicles to the larger problems of planning a city or a countryside. Much more is indeed being done than Mr. Carrington suggests to interest the general public in design, and he does not mention the distributor, the advances recently made in the education of salesmen, or the efforts of the Royal Society of Arts to raise the status of the artist in industry. Apart from such omissions, Mr. Carrington covers the field well, and the brief notes on books appended to most of the chapters contain numerous excellent suggestions for the guidance of those who wish to proceed further with any particular subject.

The appearance of the book is opportune even in war-time for two further reasons. In the first place, as Mr. Milner Gray has pointed out, industrial design is of the utmost national importance in the development of our export trade. If we are to maintain our position in the markets of the world which remain open to us, or to capture those to which Germany no longer has free access, the design of our export goods must be second to none. It will not be sufficient to produce the most obvious export goods under the rigorous conditions now existing. We must demonstrate that on top of meeting all our war-time needs, we also have capacity for quality production.

The importance of this to our economic position is obvious. If we cannot get loans, we can in this way obtain orders for goods, the making of which is as truly war work as any other. For this purpose the mere repetition of old patterns and shapes will not suffice. We have to show that our goods are not only better but also more attractive, and we shall have to make full use of all new good designs if the opportunity is not to be missed.

The second reason why Mr. Carrington's book is timely lies in the opportunities for improved design which should be ours in the reorganization and reconstruction which must be involved during and after the war. The profound disturbance of the fabric of our social, educational and business life under the demands of civil defence, no less than the adjustment of industry in general to meet the problems of supply or the reorientation of administration, whether in local or national affairs, present opportunities as well as problems. The present chaos in our physical surroundings persists less because we lack the knowledge of a remedy than because we lack the collective will to set things right. Not enough people have trained themselves to appreciate the nature of the problem. Scientific research and technique have far outstripped our ability to put them to proper use.

While the same principles inspire design wherever it operates, a wider cultural education is desirable if a sense of design is not to be departmentalism. This is indeed the gravest danger and the biggest obstacle to rational design in the larger matters of traffic problems or town planning and the like. A highly developed aptitude for design in a particular field may be accompanied by complete indifference to it either in the intimacy of the home or in civic or rural surroundings. The design so essential in our major collective enterprises can only be secured as individuals appreciating the value of design in some particular field are led to appreciate its importance everywhere.

Recognition of the place and value of design is indeed essential if the resources of modern science are to be utilized to rebuild our physical surroundings to serve adequately both our needs and our desires. One of the real tragedies of this age is that the divorce of the artist from the business of life has led to the great reconstruction which the machine age has necessitated being carried through without his aid. Only here and there are the new materials finding expression in new and more appropriate ways which satisfy not merely utility but also the æsthetic and creative sense.

There are indeed increasing signs that we are coming to recognize that the artist as designer is as essential a factor in our mechanized activities as he was in ancient Greece or any other period of history. If, however, in a few fields the opportunities which new materials offer for creative expression are being explored, the opportunities which are to be found in the planning of our cities, the development of transport, the preservation and development of the countryside are largely ignored. To awaken the mind of the ordinary citizen to these possibilities, to assist him to form an intelligent opinion upon them and to lend his support unhesitatingly and persistently to those seeking to use them is an urgent need, if those opportunities are not to be missed. In this task of education, leaders of art and industry with vision and creative force are imperative. Mr. Carrington's little book is well calculated to stimulate thought upon these larger issues, to facilitate the understanding which will assist the reintegration of the artist into society, and to inspire a concern for creative work which should enable us to build a nobler culture and a saner social order out of the chaos and destruction in which we are at present involved.

R. Brightman.

EARLY MAN IN UPPER EGYPT

Rock-Drawings of Southern Upper Egypt
1: Sir Robert Mond Desert Expedition, Season 1936–1937; Preliminary Report. By Hans A. Winkler. Pp. viii + 44 + 41 plates. (London: Egypt Exploration Society, and Oxford University Press, 1938.) 18*s*. net.

THE interest of the late Sir Robert Mond in the rock-drawings of the Egyptian desert was aroused by a collection of copies which had been made by Dr. Winkler in 1936; and with characteristic generosity and an equally characteristic ready appreciation of the possibilities of this line of research for the early history of man in Egypt, he undertook the responsibility for an expedition for the systematic study of the rock-drawings of Upper Egypt. In this preliminary report, Dr. Winkler summarizes and illustrates the results of his first season's work in 1936–37, dealing only with the most interesting and instructive examples, comprising about one tenth of his photographs. The material collected by the expedition has been deposited at the office of the Egypt Exploration Society, where it is available for consultation by students.

Of the possible methods of investigation, the author selected on this occasion the intensive study of a circumscribed area, choosing the country between Qena and Asswân. Most of the work has been carried out in the Eastern Desert between Quft and Qosêr, while in the Western Desert two small districts were worked near Armant, when Dr. Winkler enjoyed the advantage of being helped by members of an expedition of the Egyptian Exploration Society then excavating there.

The conditions in the two regions are markedly different. On the eastern bank of the Nile, profitable investigation was in the main confined to the sandstone formations of the Quft wadi-system, by which go the shortest routes to the Red Sea and the Sinaitic Peninsula. An old road with wells crosses the desert. On the west there are no such natural limitations. A seemingly endless limestone plateau borders the Nile, which is crossed by many roads. It is especially along such roads that rock-drawings are found; and, indeed, the presence of rock-drawings has sometimes indicated the existence of a road which had vanished. The author, however, draws a distinction. He points out that frequenters of the desert fall into two categories: those who are permanent inhabitants, such as the Beduin, and those who visit it as travellers. This distinction applies no less to early than to modern times, with the result that while drawings by travellers from the Nile valley as well as drawings by desert tribesmen are found along the lines of the roads, the drawings of the desert peoples may also be found anywhere in the desert.

Forty sites were visited. The subjects of the drawings are of a greatly varied character, ranging from purely geometrical signs to relatively realistic figures of men and animals. Boats of more than one type are plentifully represented—in fact, more plentifully than in any other group of rock-drawings, with the possible exception of Scandinavia. One rock painting only was discovered. This was in the Eastern Desert. It represents a man (dark red), archer (light red), ibex, and another animal (brown). It shows no artistic sense and its date is uncertain.

A proportion of the petroglyphs can be classified on adequate grounds as modern or ancient Arab, while others belong to either the Græco-Roman-Coptic period or the Dynastic. The majority of those of the Græco-Roman-Coptic period are assigned to the people known in antiquity as the Blemyans, a desert people, who rose to ascendency in the period from the third to the sixth century of our era. With them the camel appears for the first time in desert drawings; and its use was, no doubt, at the root of their political and economic domination.

The greater number of the drawings, however, cannot be dated with this certainty; and the conclusion as to their age rests upon the character of the drawings themselves and attendant conditions—position, superposition, patination, archæological finds, and the like. They are classified as Early, Pre-dynastic, and Prehistoric. Dr. Winkler assigns them to four distinct ethnic groups, for whom he has worked out a relative chronology.

These groups are as follows: (1) Autochthonous Mountain People, Hamites and cattle-breeders, who lived not only in the Eastern Desert, but also penetrated deeply into the Western Desert. The men wore the Libyan sheath. They may be regarded as the ancestors of the Blemyans. They appear to have outlived the elephant and giraffe, and probably introduced cattle into this region. (2) Early Nile Valley Dwellers, with boats showing affinities with those appearing on pre-dynastic pottery. This people was an intrusion from the Nile, and lasted down to dynastic times. (3) Eastern Invaders, a people previously almost unknown. They appear with boats of a foreign type, first recognized as such in Dr. Winkler's expedition of 1936. The boat, though a proof of early Mesopotamian influence, is probably of other, but unidentified, origin. This people is contemporary with elephant and giraffe, and was in contact with both Mountain Dwellers and the Nile Valley people. They did not penetrate the Western Desert. (4) Earliest Hunters, whose discovery must be placed to the credit of this expedition. They hunted elephant and giraffe, and are represented in both the Eastern and the Western Desert.

Though no specimens of the common type of Libyan sheath-wearing peoples have been found adjacent to the river on the western bank of the Nile, parallels to the older wedge-style of the Libyan sheath wearer, but with not unimportant differences, are known from the distant 'Uweinât' and elsewhere in the Libyan desert. At the same time, it is to be noted that the author claims a possible Hamitic origin for a group of drawings on the west side of and near the Nile, otherwise remarkable as the only example in the whole collection which can be called a work of art. An appendix deals with the characters of the boats and their relation to other representations of boats in early Egypt and Mesopotamia.

Dr. Winkler displays great acumen and powers of observation in his interpretation of these drawings as indications of the respective material culture, social organization and religious beliefs of his four ethnic groups. He is to be congratulated on the successful result of his investigations; and the continuation of a study which promises to throw so much light on the movements and cultures of the early peoples of these regions will be awaited eagerly.

MECHANICAL ANALYSIS OF SEDIMENTS

Manual of Sedimentary Petrography
1. Sampling, Preparation for Analysis, Mechanical Analysis, and Statistical Analysis, by W. C. Krumbein; 2. Shape Analysis, Mineralogical Analysis, Chemical Analysis, and Mass Properties, by F. J. Pettijohn. (Century Earth Science Series.) Pp. xiv+549. (New York and London: D. Appleton-Century Co., Inc., 1938.) 30*s*. net.

This interesting book is divided into two portions: the first by Krumbein deals with size determination of sedimentary particles, and the second part, by Pettijohn, is largely concerned with the optical properties of minerals. All who are interested in sediments will find this book most useful, as it contains descriptions of various techniques and methods of interpretation.

Krumbein, after discussing the collection of samples, suggests methods for the preparation of stable suspensions. One chapter is devoted to grade scales, and the advantages of a geometrical scale are pointed out. A theoretical discussion on the principles of size analysis follows, and those who are unacquainted with this subject will find a clear and adequate explanation. Although there is a wide choice of methods available for mechanical analysis, the present tendency is to use mechanically operated sieves for particles greater than 50μ, and the pipette method for smaller particles. For accurate work elutriation methods find to-day little favour in sedimentary laboratories. The pipette method is described in detail, but the accuracy of this method is not discussed. It would seem, however, important that the investigator should not only realize the experimental errors, but should also carry out occasional duplicate analyses, preferably adopting a slightly different technique. Only one page is devoted to the application of centrifugal force to mechanical analysis; a method which is most useful in fine-grained sediments.

The remainder of Part 1 is largely concerned with graphic presentation of results. Histograms, cumulative curves, frequency curves are described, as well as the elements of statistical analysis. The reader will find a clear and non-mathematical introduction to quartile measures, moment measures, measures of central tendency, of dispersion, skewness and kurtosis. Finally, some special statistical methods are briefly described and a discussion is given concerning the choice of statistical devices.

To the mineralogist Part 2 of this book is not very important, as optical methods of identification have been frequently described, but to the non-mineralogical student the inclusion of this portion will be useful. The procedure for analysis of shape and roundness is also discussed, as well as methods for mineralogical separations; but chemical methods of investigation are limited to five pages.

The book as a whole can be thoroughly recommended, and the authors are to be congratulated on collecting together from many sources a large amount of information, and thereby making it more readily accessible. J. D. H. W.

FOUNDATIONS AND DEVELOPMENT OF HEAT

A Text-Book of Heat
By Prof. H. S. Allen and R. S. Maxwell. Part 1. Pp. ix + 527 + xvi. 10*s*. Part 2. Pp. x + 531 – 849 + xi. 10*s*. 6*d*. (London : Macmillan and Co., Ltd., 1939.)

RECENT years have seen the production of several books on heat such as Roberts's "Heat and Thermodynamics" and Saha and Srivastava's "Treatise on Heat", to say nothing of more special works such as Hoare's "Thermodynamics". But the work now before us occupies a place of its own and will be welcomed by teachers who wish for something between an elementary text-book and a comprehensive treatise. It gives the best of the earlier work and at the same time includes some account of recent investigations.

The authors emphasize the fact that they treat the subject from the historical point of view, and there are full accounts of fundamental experiments by Joule and others, quotations from authorities, and many biographical notes. But while this undoubtedly makes the subject more interesting, there is little difference between the order of historical development and that of logical development, and the historical treatment does not impress the reader so much as the easy and gradual way the student is led into the subject.

There are two contrasting ways of writing a text-book of physics. One way is to give clear, concise statements suitable for reproduction in an examination and not going much beyond the range of the examination ; the other is to proceed by degrees, to build up a mental picture of every equation and to make the accounts of the experiments as full as possible. This is pre-eminently the method of the authors of this book and the reason for its 849 + xlvi pages. They read very easily because every chapter is obviously the result of teaching experience. After reading and understanding a book such as this, the average student is able to make his own synopsis of the subject, whereas if the concise statement were thrust at him at first, he might make nothing of it. It is, of course, for the student of physics the book is written ; the mathematical honours man may wish to travel faster.

Part 1 is intended for students preparing for the Higher School Certificate or Intermediate Examination in physics or for a university scholarship. The calculus is used occasionally, but the mathematical treatment is very simple. Part 2 is intended to meet the requirements of those reading for a pass degree in physics and to furnish a foundation for an honours course.

Near the beginning of Part 1 we notice the customary account of Davy's experiment on rubbing the plates of ice together. Prof. E. N. da C. Andrade (NATURE, 135, 359 ; 1935) has some hard things to say about this experiment. It was carried out when Davy was a country lad of nineteen years of age. If the ice is covered with a film of water, the friction is so small that scarcely any work is done at all, whereas if it is really dry it is liable to stick. To make the frictional heat appreciable it is necessary to have a normal force holding the two surfaces together, and then there is the well-known lowering of the freezing point and consequent melting. Again, the amount of heat required to melt 1 gm. of ice is very large ; the criterion is a very insensitive one, and no one has ever tried to repeat the experiment. The effect was due to conduction, and the experiment should cease to rank with such a convincing demonstration as that of Rumford. The customary account of the experiment must be allowed to stand in the old text-books ; but in view of these statements something different is called for in a new one.

In a book written as a text-book for definite examinations, it is not possible to be very original, and Part 1 develops on conventional lines. Everything that could possibly be asked for in the examination is given ; this is saying a lot, because examiners in physics do not keep to well-defined curricula, which makes it anything but a safe subject in Civil Service and other examinations. There are also questions from the examination papers of different British universities, with the answers.

But while this first volume is, generally speaking, on conventional lines, some things such as the steam and internal combustion engines, the liquefaction of gases, etc., are done unusually well, and the last three chapters, which deal with meteorology and the dimensions of thermal quantities, are an interesting innovation. We note in passing that the theory of the experiment of Clément and Desormes is given and that it is followed by the statement that the experiment does not work ; but we are not told definitely that Gay-Lussac and Welter's modification of the experiment is any better.

Part 2 gives more scope for originality of treatment. The first half of the book is thermodynamics, but thermodynamics treated from the experimental point of view, which makes it easier to assimilate. The experimental physicist will, of course, object to the chapter on thermodynamic functions and relations, but this is inevitable. Then after an account of the approach to the absolute zero, which includes the paramagnetic method and a full account of Nernst's heat theorem, there are accounts of the mathematical theory of conduction, convection, the measurement of radiation, the quantum theory and the modern theory of the specific heat of solids. The last thirty-five pages deal with statistical mechanics, the Bose-Einstein statistics and the Fermi-Dirac statistics each receiving a couple of pages. Larmor's indirect pressure theorem is a welcome innovation. The simplest definition of entropy is omitted, namely, that the increase of entropy of a substance multiplied by any low temperature gives the increase of unavailable energy of the substance with reference to that temperature, and there is no description of the photo-electric rectifier cell in the chapter on the measurement of radiation. It is difficult nowadays to say where heat stops and electricity begins, but we think this instrument ought to have been included. These are minor points.

The space given to statistical mechanics and probability is undoubtedly a move in the right direction. These concepts are becoming very important for the purpose of understanding the world around us. But it is not easy to write an account of them for the average student.

Altogether the work is a notable addition to the text-books on heat. It is the work of practised teachers and is written with great care. It is alive with modern information and research; besides being a text-book it is a storehouse of information, reference to which is greatly facilitated by the excellent indexes at the end of each volume. Much of this information the student will find unnecessary, but it will serve as a background to his knowledge and perhaps as a basis for research. The type and paper are excellent.

R. A. Houstoun.

SYSTEMATICS OF MILLIPEDES

Myriapoda 3, Polydesmoidea II, Fam. Leptodesmidæ, Platyrhachidæ, Oxydesmidæ, Gomphodesmidæ

Bearbeitet von Dr. Graf Attems. (Das Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Herausgegeben von F. E. Schulze, W. Kükenthal, K. Heider, fortgesetzt von R. Hesse. Lieferung 69.) Pp. xxviii + 487. (Berlin und Leipzig: Walter de Gruyter und Co., 1938.) 81·25 gold marks.

Any work on the Polydesmoidea from the pen of Count von Attems must command repsect. His contributions to our knowledge of a taxonomically difficult group have been very numerous and he is of course well fitted for the task of drawing together the threads of description and weaving them into a serviceable whole. The volume under notice begins with a list of works of reference occupying ten pages, and similar space is devoted to a clear and very useful systematic index. The author then plunges into the real business in hand to give nomenclatural particulars and full descriptions of the families mentioned in the title and to deal with all their subdivisions down to subspecies and varieties. It is a formidable task, for more than eight hundred species, certain and uncertain, need consideration.

In the nomenclatural jungles where Chondrodesmus, Allarithmus and Phlyzakium roam there are pitfalls for the wary as well as for those less careful. Even specialists find the name of Platyrhacus (a genus with more than 180 described species) difficult to spell. Since C. L. Koch first used the name in 1847, it has also been Platyrhachus, Platyrhachis, Platyrrhachus, Platyrrhacus, Platyrrachus, Platyrachus and Platyracus, but we seem to have got it right at last. Not so the family appellation, for here even Attems himself goes astray with Platyrhachidæ, a name that appears both on the cover and title page of his work.

In his description of colours, Attems meets a difficulty most naturalists encounter. Until some general colour standard is adopted it seems best to decide upon the fundamental colour 'brown', 'yellow', 'black' or whatever it may be and then to add adverbial modification where this is necessary.

In spite of the thorough treatment adopted by Dr. Attems, there is a sense of disappointment with the way in which this expensive work is illustrated. Figures that are of great value for taxonomic purposes are liberally included, they are admirably clear in spite of the variety of their sources, and the lettering is excellent, but there is no adequate reminder that we are really dealing with living animals and that it is, after all, a branch of natural history that is under consideration. We go back in mind nearly eighty years to H. de Saussure's paper on the myriapods of Mexico. To look at those wonderful plates was to realize that millipedes are really alive, and it gives the naturalist a sense of satisfaction for which the scientific accuracy of the present day is no real substitute. We want both kinds of illustration; at least a few figures of the old kind to cheer the pages and make them less dull, and to take away the impression that we are dealing with nothing but dried specimens in a museum collection and that the subject is a drab one. *Eutheatus erythropygos* (Brandt, 1841) is a good example because it is on de Saussure's first plate. Attems gives us a neat little figure (after Carl) of the gonopod, and very useful it is; but how much more satisfactory it would have been if we could have had de Saussure's delightful drawing of the whole animal reproduced as well. When no figure of the gonopods is available, it is still more to be deplored that no such illustration as that given by de Saussure is included by Attems. An instance of this is provided by *Rhysodesmus zapotecus* (Sauss.); de Saussure admirably depicts the whole animal.

Sometimes the treatment adopted by Attems is difficult to understand. Take *Platyrhacus* (*Tirodesmus*) *mexicanus* (Lucas); although Attems gives no description, this species is fully described and segments figured by de Saussure. Of the species *P*(*T*) *bilineatus* (Lucas) which de Saussure regards as near *P*(*T*) *mexicanus*, Attems gives a full description with one figure (side-view of gonopod).

When all is said, however, and we come to the end of a series of minor criticisms, we feel that Count Attems has done systematists a great service. More power to his pen!

S. GRAHAM BRADE-BIRKS.

GEOLOGY OF INDIA

Geology of India

By D. N. Wadia. Second edition. Pp. xx+460+20 plates. (London: Macmillan and Co., Ltd., 1939.) 24*s*. net.

THIS book, which from its first appearance has been the standard text-book of Indian students, has now been brought up to date by the addition of recent advances in Indian geology. The new geological map is an added attraction.

The revision has not, however, been sufficiently far-reaching and thorough. As a result, a novice to the subject of Indian geology will occasionally be puzzled by finding both the old and the modern view stated without due explanation.

The Salt-Range is regarded (p. 104 and Fig. 8) as a block-faulted structure, but later in the book we are told that over-thrust faulting is a marked structural feature.

On pp. 146 and 147, it is noted that the Upper Gondwanas of the Madras coast and probably the Rajmahal beds also must now be regarded as Lower Cretaceous and not as Jurassic. These recent conclusions—the work of Dr. Spath and Prof. Sahni—should have caused a more extensive revision of the whole subject, including alterations in the tables on pp. 51 and 130.

In the table of the Siwalik stages on p. 271, the views of Dr. Pilgrim as to age are given. But in a later table on p. 280 we find an entirely different view of the ages put forward by Dr. de Terra. An explanatory note was here called for.

Before writing his account of the Bagh Beds and the "Cenomanian Transgression" (p. 206), Mr. Wadia would have done well to have studied the views of Dr. Spath on the subject (*Pal. Ind.*, New Ser. **15**, Part 5, 64).

The account of the Samana section and the Hangu Shale fauna is too brief in view of its importance (see p. 246).

Perhaps the most disappointing chapters are those dealing with the Indian pre-Cambrian. There is no basis for the separation of the Himalayan pre-Cambrian into Archæan and Algonkian, as is attempted on pp. 81 and 99, and, as the age of the supposed Burmese pre-Cambrian is even more doubtful, it was not correct to place the Mergui series in the Archæan (p. 54).

Considering the great advance made in the study of the Peninsular pre-Cambrian by the Indian and Mysore Geological Surveys of recent years, the account is meagre and not free from intermixture of old and new views (for example, age of Bundelkhand gneiss on pp. 62, 63 and 73). The modern correlation of these rocks should have been given, and the views of M. S. Krishnan (Twenty-second Indian Science Congress, 1935), which admirably express the general opinions of the staff of the Indian Geological Survey, might have been studied.

In short, the entire rewriting of these chapters, and of that dealing with the Upper Gondwanas, would have improved the book. Nevertheless there is much valuable new material, especially regarding the Salt-Range, North-West India, and Kashmir. The structure of the Himalaya—the results of the work of West, Auden and Wadia himself—is excellently summarized in Chapter xxv. Those portions dealing with marine fossiliferous rocks and with economics are also of a high standard, and, in spite of such defects as those noted above, Mr. Wadia is to be congratulated on his new edition.

G. DE P. COTTER.

ERNST ABBE (1840-1905)

THE ORIGIN OF A GREAT OPTICAL INDUSTRY

THE great optical works of Zeiss in Jena, employing round about ten thousand people, is one of the leading firms of the world in the production of fine optical apparatus. This firm owes its high scientific standard, its economic efficiency and its growth to the creative genius of Ernst Abbe. The optical works of Carl Zeiss were originally the workshop of a skilful mechanic producing the necessary equipment for the laboratories of a small provincial university. The scholar Abbe gave to the mechanic Zeiss the results of his original scientific research. This was then leading to new methods in the design of optical apparatus, especially of microscopes. Those new instruments were of extraordinary perfection, so that an enormous demand from every part of the world made possible an extremely rapid expansion of the business. When after twenty years of growth, the well-known company had developed, Abbe renounced all his rights and gave the firm of Zeiss a constitution which has enabled it to survive its creator and to continue into our own turbulent times.

Ernst Abbe was born on January 23, 1840, as the eldest child of a poor workman. It was beyond the means of his father to provide a higher education for him. The boy started in an elementary school. Later, the generosity of the employers of the father secured a scholarship at a higher school for the boy, who early showed signs of an unusual intelligence.

In 1857, Abbe began his studies in Jena, which was at that time still a small town with a population of less than seven thousand. Jena was living then in idyllic isolation from the great world ; no railway touched it. The university was incredibly small. Its faculty of science consisted of three professors only, who were paid an average salary of £30 a year. Abbe studied in poverty ; his father could provide very little for him. He augmented his income by giving private lessons. It is not surprising that he had to live in the cheapest quarters, and it was no unusual event for him to replace a hearty meal by a pipe of tobacco. But in spite of all hardships, the two years in Jena meant a happy time for Abbe, who there acquired a knowledge of the fundamentals of the mathematical and physical sciences.

In 1859 Abbe continued his studies in Göttingen. He left Göttingen in 1861 with a Ph.D. The next two years were spent as lecturer to a private physical association in Frankfort. Although this engagement for popularizing science was not to the taste of a personality like Abbe, it brought him social contacts which proved to be important. When, in 1863, he was admitted as an unpaid lecturer at the University of Jena, a rich merchant of Frankfort enabled him to start his academic career by a personal grant sufficient to cover all his initial expenses. During his early years Abbe was kept busy with running practical classes and with preparing and delivering lectures. This was the beginning of his activity as a university teacher, which was destined to last for thirty-five years until 1898. He became associate professor in 1870 and full professor in 1878. He refused the most tempting offers of appointments in other universities, and spent the whole of his time in Jena. During the course of time he gradually dropped his mathematical lectures, specializing more and more in physics and eventually in optics only. His last lectures were of the widest interest, and were attended by the staff of his industrial co-operators and by distinguished scholars from all over Germany. From his early years he was closely attached to the professor of physics, K. Snell, whose daughter Elise he married in 1871.

While still a young lecturer, in 1866, Abbe came in close contact with Carl Zeiss. The little workshop of Zeiss was then successfully producing simple microscopes which could well compete with other instruments of this kind. All these microscopes were made according to a practical tradition developed by empirical methods. Abbe was the first to introduce scientific methods and systematic design. He recognized that the magnification of an even ideally corrected microscope was limited. There were no prospects whatsoever of resolving optically two parts of an object separated by less than about half the wavelength of the illuminating light, that is, about 0·0003 mm. This is of the greatest importance, because it indicates clearly that the only possible way of developing the microscope was by elimination of the optical errors within the limitation of reasonable magnification. Two lines of attack were available : first, the geometrical shape and the arrangement of the refracting lenses ; secondly, their physical properties, that is, their refraction and dispersion. Abbe made fundamental progress in both directions. His new results were at once applied in the optical workshops of Zeiss.

The new microscopes were far better than anything on the market, and thus the business of Zeiss's workshop expanded rapidly. Soon after (in 1876), the sale of the three thousandth microscope was celebrated, and in the same year a contract was concluded making Abbe an equal partner in the business. The glass sorts which were commercially available and which Zeiss used as a raw material were very much alike. Abbe tried to interest leading glass manufacturers in the production of new glass sorts with different optical characteristics. The small quantities of glass consumed in the microscope industries, however, did not guarantee a reward for these expensive experiments. In an interesting lecture during the London international exhibition in 1876, Abbe tried to interest scientific societies in his problem, but he was unsuccessful.

Abbe's appeal, however, was taken up by a young glass manufacturer, O. Schott, who was able to see beyond the immediate small practical prospects towards the great scientific and technical importance of the problem. Schott's father owned a small factory producing plate-glass in eastern Germany. Abbe persuaded Schott to move to Jena and to start a glass technical laboratory with him. New glass sorts—especially borate and phosphate glasses—were developed there, opening up new prospects for the optical industry. From this laboratory arose the famous Jena glassworks. In 1884 these glass works were started with twelve employees; the Ministry of Finance of the State of Prussia secured a subvention for the first two years. In the years which followed, the Zeiss works took up the manufacture of all kinds of optical gear, including, besides microscopes and telescopes, fine photographic objectives, prism-telescopes, telecomparators and periscopes, which are all produced in relatively large quantities. Of more specialist interest is a large number of types of other apparatus which were originally designed by Abbe, for example, spectrometers, refractometers, spherometers, apertometers and many more.

In the meantime, the firm of Zeiss expanded year by year. In 1899, a thousand workers were employed. At the time of Abbe's death in 1905, the number of 1,500 employees was passed. Before the War of 1914–18, six thousand employees were engaged in the works. Owing to the heavy demands for optical gear for war purposes, this number increased temporarily to nearly ten thousand, but it dropped to a half this number immediately after the War. Since then, the number of employees has gradually increased again, and to-day it has probably passed the former peak-level.

Of Abbe's scientific papers his discussion on image production in microscopes is still of great interest. At the age of twenty-eight, he formulated his famous sine law. A few years later, in a fundamental theory, he demonstrated the connexion of the projection of optical images with the diffraction of light waves. According to his theory, the aperture of the microscopic objective has to be large enough to collect an essential part of the diffraction pattern.

It is remarkable how quickly Abbe's discoveries became known in England. He was in the closest contact with English men of science—Crisp, Mayall, Wenham, Lettsom and Stephenson. A correspondence of more than a thousand letters with these English friends is preserved. All of them showed the greatest affection and admiration for Abbe. Stephenson wrote of him:

> "Objectives and their laws lay hid in night,
> God said: 'Let Abbe be, and all was light.'"

Abbe had worked for fifteen years managing and directing the great optical firm when, in 1891, he gave it its well-known constitution. He renounced all his property rights, making himself an employee of the great organization. The fact that one of the statutes of the constitution limits the maximum salaries in this firm to ten times the amount of the minimum wage paid, shows that the remuneration of the directors cannot be excessive. The Zeiss Institution is registered as the legal owner of the company, no shares being issued. Care and custody of the Institution is entrusted to the Ministry of Education of the country. The undertaking, however, is not subject to the control of the Government administrator, but solely to the provisions of the charter, and the function of the official administrator is to see that these provisions are carried out. The works are controlled by a board of three or four directors who have to be elected by the Minister of Education from the scientific staff and from the technical and administrative employees of the company. All the earned income is received and distributed by the Zeiss Institution. In these circumstances, the employees enjoy extraordinary benefits and their health and social welfare are first considerations.

Abbe was a true Christian, though he was not a member of any official church, and, declaring himself a dissenter, he even avoided any contact with organized religion. In opposition to many relatives and to his father-in-law, he refused the religious ceremony for his marriage and the christening of his two daughters. Politically, Abbe may be called a liberal; he joined in his later years a liberal democratic party. He disliked any extreme nationalism; he was known even to be in opposition to the policy of Bismarck. Any racial prejudice of 'blood and soil' was quite alien to his mind. His closest co-operator and friend, S. Czapski, whom he chose as his successor in leading the great organization, was of purely Jewish descent.

Later in life, Abbe suffered from insomnia, which he tried to overcome by an excessive use of drugs. In the end his nervous system showed all the signs of exhaustion and at the early age of sixty-three he had to retire. Two years later, in 1905, he died from pneumonia.

It will be widely agreed that the firm of Carl Zeiss occupies the first place among the optical firms of the world. This distinction is merited on the ground of the size of the firm and the variety of its products, coupled with the general excellence of its work. Its reputation for many years has been so high as to have given rise to a superstition that any Zeiss instrument is better than a corresponding instrument made by any other firm. In passing, it should be said that this superstition has many adherents in Great Britain, though it is unquestionably and inevitably false. Just as other firms have imitated Zeiss instruments, so a number of the finest Zeiss products are more or less copies of designs introduced by other manufacturers; indeed, the firm makes a special point of knowing exactly what its rivals are producing, and to this end makes a practice of purchasing on the open market a sample of all new designs of optical instruments. But the fact that the lead in particular instruments changes at times from one maker to another in no way detracts from the many valuable contributions made by Zeiss to the progress of optical science.

The foundations of the firm's greatness were laid by Abbe. Its reputation in the first place was built on the notable improvements he introduced in the microscope. It is interesting to note that from the beginning he followed the plan, which has since proved so valuable to the firm, of publishing papers in scientific journals.

Abbe's theory of image formation in the microscope has been of great assistance to large numbers of microscopists, though many physicists find Rayleigh's treatment of the subject more fundamental and convincing. Among the new glasses produced in an endeavour to secure better microscopic images were some which led to greatly improved photographic lenses—the anastigmats—Zeiss being one of a number of firms to bring out new designs at about the same time.

Although these new instruments were calculated trigonometrically on lines laid down by Abbe, whose aim was to use computers with limited mathematical knowledge, the problems involved were considered in a general way in a treatise planned by S. Czapski. This and a number of later volumes, notably those due to M. von Rohr, are among the best modern works on optics and have added to the prestige of the firm.

The prosperity of Zeiss to-day is in no small measure due to the form of control set up by Abbe—there are no shareholders and no family claims, so that it has always been possible to secure the finest machine equipment as well as to advertise effectively, and to select able men for responsible posts. The great size of the business, which in part was brought about by the large continuous demand for military instruments for the German Army, has enabled research and development to be carried out on a scale impossible in much smaller businesses. By way of illustration, the firm studied the problems that would be presented if maps were to be prepared from photographs. The outcome was the construction of a series of instruments, used to-day in several countries, for mapping from aerial photographs. Some of these instruments are of extreme complexity; despite their great interest and the ingenuity shown in their construction, they have found less favour in Great Britain than in other countries. As another example, possibly built largely for their advertising value, the Zeiss planetaria may be mentioned.

In recent years the firm of Zeiss has built a number of beautifully designed and made instruments of great value to engineers in setting up difficult work accurately, and in other ways. A number of laboratory instruments has also been marketed, but some of these show a tendency which ought to be discouraged. Instead of measurements being recorded on scales which can be defined apart from the instrument, readings are obtained which must be compared with others made on the same type of instrument. Apparently conversion to values obtained in other ways can only be made if the Zeiss apparatus is purchased to experiment with. This course appears to have been adopted deliberately: it tends to create a closed market for instruments in fields where one or two leading investigations have been carried out with Zeiss apparatus. The remedy is clearly in the hands of scientific workers.

This note must not close without reference to the equipment made for ophthalmic opticians and to the firm's spectacle lenses. Apart from such special products as contact lenses and cataract lenses, the Punktal series of lenses is designed to give the best possible vision over a large field with the most varied kinds of visual correction. This is a service of great humanitarian value. The moderate price of these lenses, which are highly finished, shows that the firm can manufacture a wide variety of aspherical surfaces with good accuracy by mass-production methods.

CARBON MONOXIDE AS A HAZARD OF POLAR EXPLORATION

BY PROF. YANDELL HENDERSON AND J. McCULLOUGH TURNER, YALE UNIVERSITY

PETER FREUCHEN, speaking from his long experience in the Arctic, has said recently that "only when modern times came in did the exploration of the Polar regions begin to amount to anything real. The invention of the Primus stove did more than anything else. After that came the dog sledge." Certainly modern polar explorers have a great advantage in the hot food and ample supply of drinking water that the Primus stove affords.

THE PRIMUS STOVE AND NANSEN COOKER

Shackleton, in describing the outfitting of his expedition to the Antarctic, says, "a vitally important article of the equipment for the Polar explorer is the cooker and cooking stove. Here again we are indebted to the practical genius of Nansen, who designed the form of cooker that is now invariably used in Polar work. The stove was the ordinary 'Primus' burning kerosene vaporized in the usual way. This stove is highly efficient and with strict economy one gallon of oil will last three men for ten days, allowing three hot meals per day. This economy is due in a large measure to the qualities of the cooker. The form we used consisted of an outer covering of aluminium drawn out of one piece, inside which was a ring-shaped vessel so designed that the heated air could circulate around it. Inside this vessel was the centre cooking pot, and these pots were all mounted on a concave plate of aluminium which fitted over the top of the Primus lamp. The middle cooker was first filled with snow or ice, pressed tightly down, the lid was put on and this vessel placed inside the outer, ring-shaped cooker, which was also filled with snow ; over all this apparatus the aluminium outside cover was placed, inverted. The heated gases from the stove, after heating the bottom of the centre cooker, mounted into the space between the two vessels and then were forced down the outside of the ring-shaped cooker by the cover, finally escaping at the lower edge. Experiments showed that about 92 per cent of the heat generated by the lamp was used in the cooker, a most satisfactory result, for economy in fuel is of great importance when the oil has to be carried on sledges. . . . Such was the efficiency of the cooker and the stove that, in a temperature of 40 or 50 degrees below zero, the snow or ice, which would be at this temperature, could be melted and a hot meal prepared within half an hour from the time the cooker was first placed on the Primus. The whole apparatus, including the Primus, did not weigh more than 15 pounds."

Such are the advantages of the Primus stove and Nansen cooker. It has only recently been realized that in this combination lurks a danger—that of asphyxiation by carbon monoxide—greater perhaps than any other to which modern arctic explorers are now exposed.

Beside the fatalities, which leave no witness, there have been several narrow escapes. Amundsen was once near death from asphyxiation during his exploration of the North-East Passage. Byrd has recently published an account of how near he came to collapse from a badly adjusted kerosene stove ; but in his case fumes additional to carbon monoxide were also involved. Stefansson has now focused attention on this hazard and its insidiousness. He reports that, in a snow house that became iced and impervious to gases, one of his Eskimo companions "all at once threw himself backward upon the bed. I asked Anderson to see what Tannaumirk was up to—and Anderson fell face forward on top of Tannaumirk. I extinguished the Primus stove. Natkusiak broke away the loose block of snow by which we had a few minutes before closed up the door. He then crawled outside on all fours, but was too weak to stand up. I followed him out and had strength enough to stand up. But that was only for a moment and I fell down beside Natkusiak." Fifteen minutes after the door was opened, Anderson crawled out and after another ten minutes, Tannaumirk, "but neither had any realization of what had happened." An hour later three of the party were well enough to go into the house again, but "Tannaumirk was ill throughout the night and into the next day". All the features of this adventure—including the collapse on reaching fresh air—are characteristic of partial asphyxiation and justify Stefansson in referring to it as "the narrowest escape from death we had on our whole expedition".

With this experience in mind Stefansson, in his "Unsolved Mysteries of the Arctic", has discussed the question, "How did Andrée die ?": and has marshalled the evidence suggesting that that intrepid explorer, and at least one of his two companions, died of carbon monoxide asphyxia. The tragedy, as told in "Andrée's Story", the official account published by the Swedish Society for Anthropology and Geography, was briefly as follows: On July 11, 1897, after several years of careful preparation Andrée and two companions, Strindberg and Fraenkel, embarked from Spitsbergen in a balloon and floated away over the Arctic sea. Their object was, if possible, to get close enough to the North Pole to permit them to land on the ice and walk back to the coast. For that part of the expedition they were fully equipped.

They disappeared for thirty-three years. Then, in the summer of 1930, by pure chance, their remains were found on White Island, a bit of land between Spitsbergen and the Franz Joseph Islands. Enough of their records were salvaged and later deciphered to show that, although they had not attained the Pole, all else had gone essentially as planned until, on their return journey, White Island was reached. There, in some unexplained manner, Strindberg lost his life and was buried; and a day or two later Andrée and Fraenkel appear to have died peacefully in their tent.

Carbon monoxide is believed by Stefansson, Pallin, Sverdrup and others to have been responsible for two of the deaths. The Swedish committee, on the contrary, even after the most thorough investigation, has not felt justified in adopting this hypothesis. A critical piece of evidence is lacking; it concerns the Primus stove.

The Primus stove which Andrée and his companions used, was found in good condition and still contained some fuel. But it is uncertain whether the pressure-release valve was open or closed. In carbon monoxide asphyxia, muscular control fails when the blood is about 50 per cent saturated with the gas; unconsciousness occurs at about 60 per cent saturation; and death at 75–80 per cent. If then this valve was open, the explorers must have been still conscious and able to move; and their blood was probably not more than 40–50 per cent saturated with carbon monoxide, when they turned this valve and extinguished the flame. In that case even a slight leak of air in and out of the tent or snowhouse would have prevented asphyxiation. If, on the contrary, the valve was still closed when the stove was found, they must have neglected to turn the valve, release the pressure in the stove, and extinguish the flame. The Primus then continued to produce carbon monoxide, until the gradual fall of pressure in its reservoir and cessation of the flow of kerosene extinguished the flame. But before that occurred, the blood of the explorers became 75–80 per cent saturated with that gas; and they died. The question will probably remain for ever undecided.

CONDITIONS FOR PRODUCTION OF CARBON MONOXIDE

Whatever the fate of Andrée and his companions may have been, it is important for future explorers to know whether a Primus stove, with vessels above it for cooking and for melting ice, arranged as that of Andrée was, is capable of producing, within one or two hours, sufficient carbon monoxide to render the atmosphere of a small tent or hut lethal, and whether the arrangement may not be altered so as to eliminate this hazard. This we have attempted to determine.

The Primus, although it consumes liquid fuel, is essentially a gas stove. Like other gas stoves, it may produce carbon monoxide in any one or two or all of three ways. If the supply of air to the flame is inadequate for complete combustion, or if the draught in a flue above the flame is insufficient to carry off all the products of combustion, some of the carbonaceous substances in the gas are oxidized only to carbon monoxide, instead of carbon dioxide. The other mode of production of carbon monoxide is not so generally realized, although it is probably quite as common. It occurs whenever a tea kettle is heated over a gas ring with a fairly large flame. That part of the flame which impinges upon the kettle or other vessel is cooled below the temperature requisite for complete combustion; and carbon monoxide is formed and escapes. Similarly in gas water-heaters in which the flame plays upon a coil of metal pipe through which the water flows, dangerous amounts of carbon monoxide may be formed. For the health of our cooks, even if on a given consumption of gas the kettle heats more slowly, the rack on which the kettle rests should support it 2–3 centimetres higher than is common now and just above the flame, instead of in it. For safety all gas heaters should have flues.

Mere inspection of the diagrams of the Primus stove and Nansen cooker in Nansen's "Farthest North", "Andrée's Story" and other books of polar exploration is sufficient to raise a suspicion that one or even all these conditions for the production of carbon monoxide have vitiated their cooking apparatus. The access of air is not entirely free. The passage through which the burned gas must pass is long and for half its length is against gravity; and the Primus appears to be held so close below the central cooking vessel that a considerable part of the flame impinges upon the vessel.

For the analysis and improvement of these conditions the first question to be decided is whether the stove itself is responsible for a production of carbon monoxide, or whether it is the arrangement of the cooker above it that is to blame. To decide this and related questions we made use of a galvanized iron box or chamber of one cubic metre capacity in which the stove and vessels were placed for a few minutes at a time. An electric fan kept the air in the chamber thoroughly mixed. A metal rod inserted through the wall of the chamber enabled us to turn off the pressure-release valve on the stove and extinguish the flames before the chamber was opened. The oxygen remaining in the air at the end of each test was determined by means of a Haldane apparatus and the carbon monoxide by means of an iodine pentoxide train.

The Primus, when well pumped up (50 strokes of the pump) and burning freely, produces a remarkably clean, hot flame. When it was tested with no small vessel above it in the cubic metre chamber, we found that it produces virtually no carbon monoxide at all. It produces very little even when—after it has burned for three or four minutes—the oxygen of the air in the chamber has been reduced nearly to 17 per cent, at which point the flame is extinguished.

When a cooking vessel full of cold water was placed upon the frame over the stove at such a height that the upper part of the flame impinged upon the vessel, some carbon monoxide was produced. But the amount was sufficiently small so that the concentration of monoxide in the air in the chamber rose to only 2–3 parts of that gas in 10,000 of air, or 0·02–0·03 per cent, before the oxygen in the air had been reduced nearly to 17 per cent and the flame was nearing extinction. From this we infer that a man could sleep fairly safely in a small airtight room, or hut, with a Primus and one cooking vessel. The flame would be extinguished by the decrease of oxygen before enough carbon monoxide could be produced to endanger him, although he might wake with a headache. He would not be appreciably affected by the decrease of oxygen to 17 per cent. (For comparison it may be recalled that a candle is extinguished at about 17 per cent of oxygen, but a Bunsen burner or 'gas ring' burning town's gas is extinguished only at 12 or 13 per cent of oxygen, which are about the amounts at which a man begins to be markedly affected even during a short exposure.)

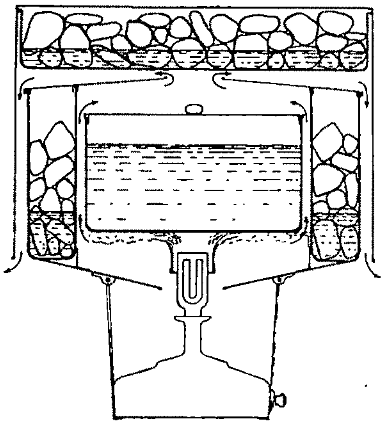

FIG. 1.

PRIMUS STOVE AND NANSEN COOKER AS COMMONLY USED IN POLAR EXPLORATION. HEATING EFFICIENCY UP TO 90 PER CENT. FOR EACH LITRE OF OXYGEN CONSUMED, 20–30 C.C. OF CARBON MONOXIDE MAY BE PRODUCED. IN A SMALL AIRTIGHT CHAMBER ENOUGH CARBON MONOXIDE MAY ACCUMULATE TO ASPHYXIATE A MAN BEFORE THE DECREASE OF THE OXYGEN IN THE AIR TO ABOUT 17 PER CENT EXTINGUISHES THE FLAME OF THE PRIMUS.

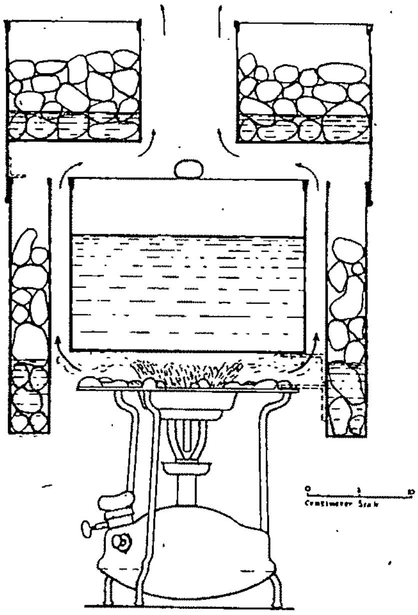

FIG. 2.

PRIMUS AND MODIFIED FORM OF COOKER. HEATING EFFICIENCY ABOUT 70 PER CENT. IF ANY CONSIDERABLE PART OF THE FLAME IMPINGES ON THE CENTRAL POT SMALL AMOUNTS OF CARBON MONOXIDE ARE PRODUCED. IF THE DISTANCE BETWEEN THE BURNER OF THE PRIMUS AND THE BOTTOM OF THE CENTRAL POT IS SUFFICIENT—3–4 CM.—SO THAT THE COMBUSTION IN THE FLAME IS COMPLETE BEFORE THE FLAME IMPINGES ON THE POT, NO CARBON MONOXIDE IS PRODUCED.

When not only the cooking vessel was placed above the Primus, but also the annular vessel for melting ice was placed around it and an additional pan over it, but without the final cover of the cooker, the flame still burned brightly without the slightest smoke or soot; and the concentration of carbon monoxide in the cubic metre chamber did not rise appreciably higher than with only one vessel on the stove.

When, however, in addition to the three vessels, the cover was placed over all, as Nansen, Andrée and others have all used the Primus and cooker, the production of carbon monoxide became so considerable that 8–10 or more parts of that gas in 10,000 of air were developed in the chamber before the flame was extinguished by the decrease of oxygen; and 8–10 or more parts of carbon monoxide in 10,000 of air, if inhaled for more than an hour, can induce a dangerous degree of saturation.

The reasons for the elaborate arrangement of the three vessels and a cover over all, as first adopted by Nansen, were economy and efficiency in the use of fuel. In our hands when well pumped up and burning strongly, the Primus (silent type, large size, capacity 1,100 c.c.) consumes 4–5 grams of kerosene (liquid paraffin) per minute. Taking into account the heat of combustion, the volume of water and the increase of temperature in the contents of the vessels, we have found that when only one vessel is used the efficiency is only 50–60 per cent. When all three vessels are used, but without the cover, the efficiency and economy rise to 70–80 per cent; and with the cover over all, it reaches 80 or even 90 per cent, as Nansen, Shackleton, and others have reported.

With these facts before us, it appears that in Nansen's arrangement (Fig. 1), safety has been too far sacrificed to economy. We suggest, therefore, that the metal cover be omitted, and one of asbestos, or felt, or blanket substituted, with a vent sufficiently wide to offer no obstruction to the escape of the products of combustion; and in addition that some such arrangement of the vessels as that shown in Fig. 2 be adopted: an arrangement suggested to us by Mr. Anthony Fiala.

Even with this arrangement, in which there is a full supply of air and a good draught, some carbon monoxide is produced when the distance between the inner, or cooking, pot and the top of the Primus is so small that some of the flame impinges upon the cold surface of the pot. We find, however, that if this distance is increased so that it is 2 cm. more than the distance now provided between the top of the burner of the Primus and the bottom of the vessel when the vessel is set directly upon the frame of the Primus—or 3–4 cm. in all between burner and pot—no carbon monoxide whatever is produced. With this arrangement, the efficiency of the stove is, however, decreased; and only about 70 per cent of the heat produced by the burning of the fuel is caught in the contents of the three vessels of the cooker.

Whatever arrangement of the cooking and melting vessels may be adopted by future explorers, it would be well, before the expedition starts, to test it by filling the vessels of the cooker with ice and placing it with the lighted Primus in a small room, together with an electric fan to mix the air, and a canary, white mouse, or rat. To be safe, the depletion of oxygen in the chamber should extinguish the flame before the test animal is noticeably affected. With the modified cooker this test may be performed by conducting some of the air from the cooker into a box in which the animal is placed.

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NEWS AND VIEWS

Gold Medal of the Royal Astronomical Society

THE Gold Medal of the Royal Astronomical Society has been awarded to Dr. Edwin Hubble, Mount Wilson Observatory, California. Edwin Hubble joined the staff of the Mount Wilson Observatory in 1919. His first work was an investigation of the spectra and luminosity distributions of galactic nebulæ, and he established the now accepted connexion between the light from such nebulæ and the spectra of the stars involved. He proceeded to a general classification of what are now known as extra-galactic nebulæ, and then turned to intensive studies of M31 and M33, which considerably extended the list of novæ observed in them, and he identified Cepheid variables of galactic type as occurring in them. By means of the period-magnitude law for Cepheids he evaluated the distances of these nebulæ, which led in turn to estimates of their dimensions and masses and definitely established not only their extra-galactic nature but also their general similarity to our own galaxy. From this fundamental work followed the recognition of the nebulæ in general as extra-galactic but comparable with our own galaxy in structure. The 'island universe' controversy was thus settled.

Combination of nebular distances with measures of red-shifts (discovered by Slipher but enormously extended by Hubble and Humason) led to the enunciation of the 'velocity-distance proportionality', often called Hubble's Law. This law underlies all modern theoretical cosmology and the concept of the expanding universe. Recent refinements due to Hubble himself have called in question the interpretation of the red-shifts as velocities; but, in whatever form, the apparent increase of velocity at the rate of about 500 km. sec.$^{-1}$ per 10^6 parsecs is a fundamental world-datum. Hubble's more recent researches have been concerned with the distribution of the nebulæ in space and the discovery of their average homogeneity, modified by a tendency to form groups and clusters; with the determination of the mean density of matter in space, another fundamental constant; with space absorption and obscuration in the galactic plane; with the effects of red-shifts on apparent magnitudes; and with the character of the 'local' group of nebulæ. It may fairly be claimed that the modern picture of the universe of extra-galactic nebulæ is largely due to Hubble's researches. He has recently collected them in a book, "The Realm of the Nebulæ", a work of epic quality. His contributions are characterized by the power and originality of his methods, by his observational skill, by the objective character of his deductions and by the general brilliancy of his results.

The Earthquake in Turkey

THE first official estimate of the earthquake losses was given to the Kamutay on January 11 by the Health Minister, who said that there were 23,131 dead and 7,994 injured and that 29,131 houses had been ruined. Further news of the disaster comes from the affected areas as communications are restored. The Susheri district north-east of Erzinjan had been completely cut off for a fortnight except for the dropping of food and medicaments by a squadron of aeroplanes. There were 3,950 dead and 590 injured. It appears that the Malatia Erzinjan railway was not so greatly affected by the earthquake as the Sivas Erzinjan line, though the blizzards and snow affected this line tremendously. According to eye-witness accounts from Rechadiye, there were crevices 400 yards long and several yards wide in different directions. Streams and rivulets have changed their courses. At a place 12 kilometres from Rechadiye a mountain had its shape completely altered, giant precipices being formed and roads being blocked. The Yeshil-Irmak overflowed and further threatened Amasya.

Sailors report that between Kerasun and Shebin-Karihisar an entire mountain has subsided. Photographs from Erzinjan show that movement there took place in all directions, as there appears to have been no predominant direction of fall of the columns and other debris. The town of Erbaa near Tokat has apparently suffered almost as much as Erzinjan, and in many places the bursting of drains due to the earthquake and floods has added new terror. It is reported that typhoid has broken out at Fatsa. After-shocks of decreasing intensity have been felt at intervals in the widely separated areas of Samsun, Amasya, Bursa, Kersund, Yozgad, Inebolu, Bolu, Burdur, Isparta, Karahisar, Erbaa, Akhissar, Odemish, Duzic, Sivas, Tokat, Bergama, Smyrna and Kikili, that is from northern to south-western Anatolia, according to a *Times* report.

The entire body of survivors from Erzinjan, numbering 3,200, have been removed to Alexandretta, Mersin, Adana and other towns of Southern Anatolia, except about 130 injured, who have been placed in hospitals in Istanbul, and the surviving military cadets who have been sent to Konia. It is reported that the Government is discussing a proposal to rebuild Erzinjan on its present site, and temporary wooden cottages are to be erected. Dr. G. Van Dyk states that the first pulse to arrive at De Bilt (Holland) after the earthquake was dilatational, and that possible after-shocks were registered there on December 27 at 22h. 44m. 3s. G.M.T. and on December 28 at 3h. 30m. 45s. and 3h. 35m. 15s. G.M.T. We are indebted to Rev. J. P. Rowland, S.J., of the Stonyhurst College Observatory, for a copy of the seismogram of the principal earthquake. This seems to indicate the possibility of three distinct shocks having occurred within the first minute. They appear to have been of increasing intensity and from very nearly the same epicentre.

Drug Standardization

THE Harrison Memorial Lecture was delivered by Mr. A. D. Powell, chief analyst of Boots Pure Drug Co., Ltd., at the evening meeting of the Pharmaceutical Society on January 9. His subject, "Drug Standardization", was chosen, he said, in token of the work done in that connexion by the late Colonel E. F. Harrison prior to his undertaking the responsibilities of his post as chief of the Defensive Gas Warfare Department during the War of 1914–18. Mr. Powell surveyed the progress of standardization from the time when, as a result of the disclosures of the *Lancet* Analytical Sanitary Commission, the Adulteration Act 1860 was passed, and concluded by outlining his own ideas of the desirable features of a satisfactory drug standard.

Mr. Powell put forward five points: (1) The description and principal requirements of strength should be free from ambiguity, and the descriptive paragraph, if it referred to a drug of definite chemical composition, should not be so restrictive as to insist on a particular method of preparation. (2) The degree of purity in terms of the substance, or of an active principle, should be defined wherever possible, unless, as with many organic chemicals, the melting point gave a sufficient indication of a high degree of purity. (3) The tests for purity should be diagnostic, and preferably capable of application under conditions varying within reasonable limits. (4) The number of tests for purity should cover all the impurities likely to be present in significant proportion, but should be limited by this consideration. (5) Tests to detect traces of unlikely impurities, or a redundance of tests for the same impurity, may weaken rather than strengthen a standard. In general, standardization should be definite and free from ambiguous interpretation; this should not enforce an academically high degree of purity involving artificially high cost of preparation without corresponding advantages in safety and therapeutic activity.

A Pioneer of the Oil Engine

As long as there are oil engines, there will be discussions as to the relative merits of the work of Herbert Akroyd Stuart in Great Britain and of Rudolph Diesel in Germany. Designers of engines to-day utilize the ideas of both, but whereas the name of Diesel has become a household word, that of Stuart is known only among engineers. It was said at the time Stuart died that he "belonged to that rather tragic fraternity of inventors whose achievements have not secured from the world at large the recognition they merited". That his work is fully appreciated in engineering circles was shown by the Diesel Engine Users' Association, which on January 11 held a luncheon at the Connaught Rooms, London, to commemorate the fiftieth anniversary of his most important patents.

After the luncheon, a sketch of Stuart's life and work was given in a paper by Mr. T. Hornbuckle and Mr. A. K. Bruce. Stuart was born in Yorkshire in 1864 and died in West Australia in 1927. He was among the earliest students of the Finsbury Technical College. While engaged at his father's engineering works at Fenny Stratford, Buckinghamshire, he began experimenting with internal combustion engines, and in the years 1886–92 took out nine British patents for improvements. His leading patents were No. 7146 of May 8, 1890, and No. 15994 of October 8, 1890. These were taken out in collaboration with C. R. Binney. In that of May 8, 1890, he claimed the novelty of compression ignition. Diesel's patent was not taken out until February 28, 1892. The manufacture of oil engines according to Stuart's patents was taken up by Messrs. Hornsby and Sons, Ltd., of Grantham, in 1891, and Stuart had little more to do with them. Unfortunately, the engines became known as "Hornsby-Akroyd" engines, and in America even as "Hornsby-Diesels". At his death, Stuart left instructions for his papers to be destroyed, but he bequeathed sums of £500 and £700 respectively to the Institution of Mechanical Engineers and the Institute of Marine Engineers for prizes for papers on oil engines.

British and American Civil Engineers

In September last it had been arranged that representatives of the Institution of Civil Engineers should visit the United States in response to an invitation from the American Society of Civil Engineers, but international unrest in Europe resulted in the cancellation of that visit. Had the visit taken place, it was intended that Mr. W. J. E. Binnie, who was then president of the Institution, should present to the American Society of Civil Engineers a replica of the Myddelton Cup, as a token of the friendly relations which have existed between the two societies. Lord Lothian has now, however, on behalf of the Institution, handed the replica to Colonel D. H. Sawyer, president of the American Society, at a gathering of the members of that Society held in Washington on January 9.

The original Cup was presented to Sir Hugh Myddelton in 1613 by the Worshipful Company of Goldsmiths of London for his services in providing London with a supply of potable water. It remained in the possession of the Myddelton family until 1922, when it was acquired by the Goldsmiths' Company. Lord Lothian has, by completing the ceremony of presentation, cemented the cordial feeling between the two societies and strengthened that part of the bond of international friendship which is based upon the creative genius of the civil engineer in all parts of the world.

Non-Political Work of the League of Nations

A report by the Secretary-General on the work of the League of Nations (July–mid-November, 1939), which has just been issued, is an immediate sequel to the regular report on the work of the League, 1938–39; but is the first of a series which will be published periodically to keep the States Members informed of the progress of the League's work (League of Nations. Report on the Work of the League (Continuation). July–mid-November, 1939. (Official No. A.6(a). 1939.) Pp. 62. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1939.) 1*s*. 6*d*.). The report shows that with certain exceptions—the European Conference on Rural Life, which was to have met at Geneva in October, for example, had to be postponed *sine die*—the League has been able to carry on, in spite of the War, its essential activities in the non-political fields in which it has been responsible for so much successful and constructive work in recent years. For the development of international co-operation in economic and social affairs, the creation of a Central Committee to direct and supervise the work of the League's Committees dealing with those questions has been recommended and a draft constitution submitted for the approval of the Assembly.

A section in the report on economic and financial questions refers to the meeting of representatives of National Nutrition Committees held at Buenos Aires in October and to measures taken to adapt the publications of the Economic Intelligence Service to the new conditions. Other sections deal with communications and transit, health questions, and traffic in opium and other dangerous drugs. It is interesting to note that maintenance of supervision of this traffic in war-time has been strongly urged by the United States of America, although not a member of the League.

Vital Statistics of a Primitive People

A study of the vital statistics of the lowland Sĕnoi (Sakai) of Perak, Malay Peninsula, by H. D. Noone (*J. Fed. Malay States Mus.*, 15, 4; 1939) is of interest in its bearing on the effect of the inter-racial and cultural contacts of a primitive people on their chances of survival. A generation ago it was regarded as a matter of time only before the then dwindling pagan tribes of the Malay Peninsula would disappear. The observations which Mr. Noone now records, however, suggest that in the group under notice recuperative forces are at work, which enable them at least to hold their own against the effects of Malayan contacts and the adoption by some of their number of the tenets of the Mahommedan faith. In the course of an economic and demographic survey in 1936, Mr. Noone found that in fourteen groups with a population estimated at 1,600 the number of children born to the average lowland Sĕnoi married woman is 4·15, the model family also being four, but with a tendency to increase. The size of the family which occurs so many times as to contribute potentially more to a future generation than any other is five. With this figure as a characteristic, there is ground for hope for the future.

Fertility, reckoned on the basis of the number of children who grow to maturity and become effective in adding offspring to the group, is assessed on the average survival figure of 3·003, the largest number of deaths before maturity taking place under the age of six years. The sex ratio is 100 females to 107·38 males born; and this is practically unchanged at maturity at 100 and 107·54 respectively. These figures, taken in conjunction with other data recorded by Mr. Noone, point to the conclusion that while groups in which contacts have been recent appear to enter upon a stage during which the population suffers a disturbance of its reproduction rate, other groups have passed through this stage and have adjusted themselves well enough to be at least as viable as their more primitive and remoter hill cousins.

Disease and Race

A CASE which is of considerable interest in its bearing upon the racial incidence and distribution of disease is reported from Egypt by S. Azmy Pasha and A. F. Zanaty of Cairo (*Lancet*, 237, December 30, 1939). The patient in question, a man, thirty-five years of age, who had lived in Cairo for twelve years, but previously to that in the country, was admitted to hospital with anæmia in August 1938 and after discharge was re-admitted in a relapse in 1939. After a fortnight's treatment without improvement, a bone marrow puncture not only excluded an aleukæmic leucosis as well as a plastic anæmia, but also showed megaloblasts typical of Addisonian anæmia. Addisonian anæmia, the authors point out, has a distinct racial incidence. It is generally regarded as a disease of Nordic races and as less common among southern races. In America also a higher incidence has been recorded among immigrants from northern Europe (Anglo-Saxon) than among those of Latin extraction. It is also regarded as further supporting this view of racial susceptibility that the Finns, out of all races, are more liable to develop the disease when infested with *Diphyllobothrium fatum*—a parasite which produces a blood-picture indistinguishable from that of genuine Addisonian anæmia. The disease rarely occurs in Asiatics and is unknown in the tropics. In Egyptians it is extremely rare. The authors, after examining hundreds of anæmias, have found only this case now recorded, while another authority has encountered two cases only since 1935.

Demography of Madagascar

IN his inaugural thesis (Thèse de Paris, No. 657; 1939) Dr. Félix Randriamanana states that a study of the population of Madagascar since the beginning of the century shows an annual rise, which was very pronounced during the first twelve years but underwent a decline during each of the subsequent twelve years. In 1936 the population was 3,777,951 as compared with 2,244,876 in 1900. In 1904 and 1908 various devastating epidemics, especially smallpox, measles, malaria and influenza, had a considerable effect upon the population. The annual birth-rate has increased from 64,847 in 1906 to 88,351 in 1936; but the increase is probably more apparent than real owing to the notification of births being carried out more completely then previously.

During 1933–36 the death-rate was 20·7 per 1,000, as compared with 28·5 in Réunion (1933–35), 24 in Egypt (1930–34), 22 in Cochin-China (1931–35) and 15·7 in France (1931–35). During the first year of life the mortality in 1934–36 was 177 per 1,000 births as compared with 83 in France (1930–34) and 206 in Japan (1934). The maternal mortality in childbirth showed a rate of 100 per 1,000 births, this high rate being due to disease and the poor constitution of the mothers. The most prevalent epidemic diseases in Madagascar are plague and malaria at the beginning of summer (December), followed in April by influenza, measles, whooping cough and dysenteries. In June and July pulmonary diseases, especially pneumonia, predominate, followed by influenza, while in September and October more or less severe outbreaks of alimentary diseases are prevalent.

Animal Organisers

Current Science is to be congratulated on presenting to Indian readers a comprehensive résumé of research on organisers ("Organisers in Animal Development", Supp. *Curr. Sci.*, August 1939, Bangalore). There are eight articles contributed by the distinguished investigators, O. Mangold, E. Rotmann, J. Holtfreter, P. Weiss, W. Luther, C. H. Waddington, S. Hörstadius and C. M. Child. Four of the articles are in German, the remainder in English. There are numerous illustrations. The subjects discussed range from the general work of organisers during development and the special factors influencing their activities, to collateral fields of research such as the study of regeneration of lost parts and physiological gradients. A certain amount of repetition and overlapping is inevitable in a series such as this, and it would have been helpful if a summary of the articles could have been provided.

The story of the experimental work undertaken by Spemann and his collaborators at Freiburg im Breisgau on blastoporic organisation centres in the amphibian egg is well known in Great Britain. The old 'epigenesis' versus 'preformation' controversy was thereby revived in a new form. Yet where has it led us? To a slightly better understanding of the laws governing development, but also to obstacles which defy further progress in the present state of our knowledge. For the moment, zoologists have exhausted the subject and await the arrival of a new idea. Some even deny the validity of the organiser theory, and it is possible that much of the work that has been done may be relegated historically to one of those attractive side avenues in science which forms a pleasant rendezvous for a while but is destined to be neglected later because it leads nowhere.

Teaching of Statistics

IN a paper read to the Royal Statistical Society on June 20, 1939, and printed, with the ensuing discussion, in its *Journal* (**102**, 532; 1939), Dr. John Wishart pointed out, among other things necessary for the progress of the subject, the urgent need for a standard treatise on its mathematical side. There are many text-books on practical statistical methods, usually restricted to one particular field of application, such as economics, business statistics, psychology, or biology and medicine, in which the reader has to accept the statements without proof. If a mathematical student asks where these proofs may be found, he may be told "You must look up the original papers, which you will not be able to understand". It is urgently necessary that a text-book should be produced to end this unsatisfactory state of affairs.

Dr. Wishart discussed in some detail what such a text-book should contain, and feared that it was beyond the powers of any one man to produce; he favoured a co-operative venture. However, many will differ from Dr. Wishart on this point, and prefer the incompleteness which may be found in the work of a single writer to the lack of unity characteristic of a book produced by a committee. In the interests of science it is desirable that we should not have to wait indefinitely until the ideal treatise can be produced. Let someone have the courage to make the attempt now; there is no one better qualified for the task than Dr. Wishart himself.

Meteorology in Southern Rhodesia

THE meteorological report of the Department of Agriculture, Southern Rhodesia, for the year ended June 30, 1938, covers the period during which the Northern Rhodesia Weather Service was taken over from the British East Africa Meteorological Service by arrangement with the Governments concerned. After the transfer, the establishment of a new air route in Northern Rhodesia was announced by the Government of that country to replace the existing route via Broken Hill and Mpika, and this led to the setting up of a first-order meteorological station at Lusaka, while arrangements were made to open another at Kasama later. Civil aviation developed to twice its initial volume during the period in Southern Rhodesia, and the Service found it difficult to meet the increased demands for weather reports. The formula used for the previous ten years for forecasting the seasonal rainfall gave a prediction of abundant rainfall for 1938–39, with a result that could not of course be indicated at the time of completion of this report. The only previous comparable prediction of abundant rainfall was for 1934–35, and was the most conspicuous of only three failures out of the previous nine predictions to forecast whether the rainfall would be above or below the average. On one of these three occasions the predicted and actual departures were so small that it can reasonably be regarded as a successful forecast, making the successes nearly eighty per cent, which is a very satisfactory result. It is stated that the predictions have proved of value, as may easily be credited in view of this high percentage. The report, as usual, includes extensive meteorological tables for a large number of stations for the year, among them those giving hourly values of several items for Salisbury Observatory.

Mistletoe, Magic and Medicine

THE October issue of the *Bulletin of the History of Medicine* contains an excellent survey by Dr. Leo Kanner, of Baltimore, of the history of mistletoe from the earliest times until the present day. The magic virtues formerly attributed to it were as follows: it was regarded as a promoter of grain and fruit harvests; a fattener of live-stocks; an incentive to milk production; a safeguard against ghosts and witches, nightmares and conflagrations; a bringer of luck to farmers, home owners, hunters, warriors, wrestlers and travellers; an agent which forces spirits to reveal their secrets; a discoverer of buried treasures, and a feeder of the mystic mandrake. It was also characteristic of its magic powers that mistletoe was regarded as a panacea, as it was used for the prevention and cure of plague, leprosy, fevers, syphilis, consumption, hæmorrhages, diseases of the heart and lungs, intestinal disorders, poor appetite, skin affections, nervous troubles and, most of all, epilepsy.

On the other hand, mistletoe was sometimes regarded as a baleful plant and was supposed to possess poisonous properties for which numerous remedies were prescribed by Galen and others. In the first half of the nineteenth century all the therapeutic properties of the mistletoe had become discredited, and it was not until 1906 that it became permanently established as a useful drug for the treatment of hypertension and later as a diuretic and styptic.

Tests of a 4,000 kw. Gas-Turbine Set

PROF. A. STODOLA, in *Engineering* of January 5, gives a description and test results of a 4,000 kw. combustion-turbine generating set, recently constructed by Messrs. Brown, Boveri and Co., Ltd., of Baden, Switzerland, for the city of Neuchâtel. The set was built for installing in a bomb-proof chamber for use in emergencies, and consists of an axial-type air-compressor, a combustion chamber, a gas-turbine exhausting direct to the atmosphere, and an electric generator. "The present-day possibilities of realising a successful gas-turbine, resulting from the improvement of the compressor efficiency on the one hand, and the availability of heat resisting materials on the other hand, would have appeared unthinkable but a short time ago."

When the set is working, with the temperature of the atmosphere about 77° F., air from the compressor is discharged at a pressure of about 60 lb. per sq. in. and a temperature of nearly 400° F. to the combustion chamber. The fuel is gas oil. Only a part of the air is used for combustion, the remainder being used to bring down the temperature of the burnt gases to about 1,000° F., at which temperature they enter the turbine. After doing work in the turbine, the gas is exhausted to the atmosphere at a temperature of about 500° F. The set is rated at 4,000 kw., and revolves at 3,000 r.p.m., producing three-phase current at 50 cycles. The thermal efficiency is 17·38 per cent. The gas turbine, says Prof. Stodola, has many promising possibilities which merit the attention of prime-mover designers and of leaders of industry.

Swiss Watch-making Industry

IN *Swiss Technics*, published by the Swiss Office for the Development of Trade, in Zurich and Lausanne, during November–December 1939, it is stated that although less trade was carried out during the first few months of the year than during the corresponding months of 1938 there was decided improvement in the summer, so that exports to most foreign countries very nearly reached the 1938 figures. This progress would certainly have been maintained had it not been for the War. It would be absurd to give way to despondency with regard to the future of the Swiss watch-making trade. There are two good reasons for looking forward hopefully. The first is the great improvements made by the industry in perfecting watches during the last ten years. The improvements have been continuous.

The 1939 steel watch is proof against fall, shock and damp. It is antimagnetic and does not oxidize. It unites a number of advantages and improvements not found in the best watches made before the War of 1914–18. The manufacturers are not afraid of losing their customers. As an example they give Great Britain, where the demand is increasing owing to the greater need for punctuality. The second reason lies in the organization of the Swiss watch-making industry. The watches are made of good materials and with great technical skill. Quite poor people will always find good watches at a price suited to their purses. Competition which the Swiss might justly have feared has now disappeared. They are therefore prepared to provide the world with the three types of watches produced by a trade that is built up on sound principles: chronometers and precision instruments, suitable for observatories, beautiful high grade watches, and cheaper watches which nevertheless keep good time. It is thus that the Swiss industry faces the great crisis.

Earth Tremors in Belgium

ON January 7 two earthquake tremors were distinctly felt in the district immediately to the east of Mons, one at about 4.30 p.m. and the other at about 8.30 p.m. These were recorded at the Uccle Observatory at 4.29 p.m. and 8.32 p.m. respectively and the epicentre appears to have been near latitude 50° 26′ N., longitude 4° 0′ E. No damage or casualties are reported. It will be remembered that a much stronger earthquake did damage to property and caused injury to ten people in Belgium on June 11, 1938 (NATURE, **144**, 950; 1939). On that occasion the epicentre was determined by the chief of the Belgian Seismological Service, Dr. O. Somville, to have been between Audenarde and Renaix, latitude 50° 47′ N., longitude 3° 35′ E. The 1940 epicentre thus appears to have been a little to the south and east of the 1938 epicentre, though any connexion between them is doubtful. The 1938 earthquake had a depth of focus of 45 km. though the 1940 one may have been superficial.

Development of Moscow

A BOOKLET recently issued in Moscow entitled "Moscow in Figures" (London: Russia To-day Press Service) shows the development of the Soviet capital in recent years. According to the figures given, during the last thirteen years the population of Moscow has more than doubled, at present numbering 4,137,000. Moscow is now the third largest city in the world. The number of workers and employees in the factories and institutions of Moscow in 1939 reached 2,300,000, as against 600,000 in 1913. In 1938 there were 117,200 births in Moscow. The city has 175 scientific research institutions in which 9,000 scientific workers are engaged. The higher educational institutions of Moscow have 95,000 students. During the last four years 350 new schools have been built. The number of pupils at present attending the Moscow schools is 608,300.

Hygiene in South China

THE November issue of the *Bulletin de l'Office d'Hygiène Publique* contains an account by Inspector-General Dr. A. Lasnet, the delegate of Algeria, of a sanitary mission sent by the Health Section of the League of Nations to South China in December 1937, six months after the onset of the war between China and Japan. The work of the mission consisted in (1) a campaign against infectious diseases, especially smallpox during the cold season, cholera during the hot season and malaria in the spring and summer; (2) wholesale destruction of insanitary houses, construction of wide sunny streets, proper disposal of excreta, and protection of the water supply; (3) education of the population in hygiene.

Detection of Toxic Gases

LEAFLETS 8 and 9 of "Methods for the Detection of Toxic Gases in Industry", published by the Department of Scientific and Industrial Research

(H.M. Stationery Office, 2*s*. 6*d*. each net) deal with phosgene and arsine, respectively. The methods used are colorimetric, the reagents being diphenylamine and *p*-dimethylaminobenzaldehyde in the case of phosgene, and mercuric chloride in the case of arsine. Full directions for performing the tests are given.

Colonial Service Appointments

THE following appointments and promotions in the Colonial Service have recently been made: M. Lunan and C. Mansfield, agricultural officers, Tanganyika Territory; A. H. Milne, veterinary officer, Nyasaland; H. W. C. Newlands, veterinary officer, Tanganyika Territory; R. H. Owen, veterinary officer, Gold Coast; C. D. V. Georgi, senior chemist, Research Branch, chief research officer, Agricultural Department, Malaya; R. R. Glanville, senior agricultural officer, Sierre Leone, principal agricultural officer, Nigeria; W. G. Leckie, senior agricultural officer, Kenya, deputy director of agriculture, Basutoland; F. A. Squire, entomologist, Windward and Leeward Islands, entomologist, Sierra Leone; C. A. Thorold, plant pathologist, Kenya, plant pathologist, Department of Agriculture, Trinidad; R. G. M. Willan, assistant conservator of forests, Nyasaland, assistant conservator of forests, Cyprus.

Prize Awards of the Paris Academy of Sciences

THE annual public meeting of the Paris Academy of Sciences was held in December, and the customary long list of prize and medal awards for 1939 has been published. Lack of space precludes publication of the complete list of awards, most of which naturally go to French workers, but the names of the following investigators outside France who received prizes may be put on record: Prof. Nicolas Coculesco, honorary director of the Observatory and honorary professor of the Faculty of Science of the University of Bucharest, the G. de Pontécoulant Prize for his studies of celestial mechanics, especially on the development of the perturbing function; Prof. Lucien Dautrebande, of the University of Liège, a Montyon (Unhealthy Trades) Prize of 2,500 francs for his researches during the past twenty years on the toxicology of the vapours of different solvents used in industry; Prof. Pierre Coulouma, of Lille, and director of the Institute of Anatomy of Fribourg, and Léon Devos, of the Faculty of Medicine of Lille, a Montyon Prize of 2,500 francs for their work entitled "Les zones pulmonaires. Anatomie et radiologie chez l'Homme. La lobation et la zonation des poumons. Études d'anatomie comparée chez l'Homme et les Mammifères".

Food Rationing: Special Diets

AT the request of the Ministry of Food, the Ministry of Health, and the Department of Health for Scotland, the Medical Research Council has appointed an expert committee "to advise from time to time on the question whether it is necessary on medical grounds to modify or supplement rations in the case of invalids and other persons on special diets". The following have accepted the Council's invitation to serve on the committee: Sir Edward Mellanby (chairman), secretary of the Medical Research Council; Prof. L. S. P. Davidson, professor of medicine in the University of Edinburgh; the Right Hon. Lord Dawson of Penn; Prof. F. R. Fraser, professor of medicine in the British Postgraduate Medical School, London; Prof. H. P. Himsworth, professor of medicine in University College Hospital Medical School, London; Dr. R. D. Lawrence, King's College Hospital Medical School, London; Dr. R. A. McCance, reader in medicine in the University of Cambridge; Dr. J. C. Spence, Victoria Infirmary, and clinical teacher in medicine in King's College, Newcastle-on-Tyne. The committee will hold its first meeting at once, when the question of diabetic diets will be particularly considered.

Announcements

DR. C. H. DESCH retired from the post of superintendent of the Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, on December 31 last, having attained the normal age limit. Dr. Desch will be succeeded by Dr. C. Sykes, of the Metropolitan-Vickers Research Laboratories, who will take up his duties at Teddington on March 1.

THE annual general meeting of the London and Home Counties Branch of the Institute of Physics will be held on January 25, in the lecture theatre of the Royal Institution, London, W.1. At the conclusion of the business, a lecture will be given by Dr. H. Spencer Jones, Astronomer Royal, entitled: "The Measurement of Time".

THE next meeting of the Plastics Group of the Society of Chemical Industry will take the form of a joint symposium with the Faraday Society at Caxton Hall, Caxton Street, Victoria Street, S.W.1, on January 26, at 6.30 p.m. The symposium will be entitled: "Molecular Size and Structure and their Influence on the Properties of Plastics". Further information can be obtained from the Hon. Secretary of the Plastics Group, Society of Chemical Industry, Clifton House, Euston Road, London, N.W.1.

THE Hotel Dieu of Quebec, the oldest hospital in Canada, and with the possible exception of one in Mexico, the oldest hospital in North America, has recently celebrated the tercentenary of its foundation.

THE centenary of the foundation of the Belgian Royal Academy of Medicine will be celebrated on September 19, 1941.

THE New York office of the United States Public Health Services is sponsoring the formation of a Society for the Study of Syphilis for all physicians in the city who are interested in the diagnosis and treatment of the disease.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 111. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Evidence for Transformation of Mesotrons into Electrons

ONE of the outstanding questions regarding the mesotron is that of its ultimate fate. Certain properties of this particle are remarkably like those of the hypothetical particle assumed by Yukawa in his theory of nuclear forces and β-disintegration, and this has led to the view that the two may be identical. Within a rather large experimental error they have the same mass, and both are unstable in the free state, having an average life of the order of 10^{-6} seconds. The disappearance of the particle of Yukawa's theory at the end of its life takes place through its transformation into an electron and a neutrino, and it is regarding this that hitherto there has been no evidence of a parallel between it and the mesotron of cosmic rays. In fact, existing experimental evidence has rather gone to show that mesotrons suffer at the end of their life some other fate than befalls the Yukawa particle.

With the object of obtaining information on this crucial point we constructed a large cloud-chamber (24 in. diameter, 20 in. deep) which, with its large sensitive period and volume, might catch a cosmic ray mesotron coming to the end of its range in the gas of the chamber. A recent photograph taken with this shows a mesotron track terminating in the gas as desired. From its end there emerges a fast electron track, the kinetic energy of which is very much greater than the kinetic energy of the mesotron, but is comparable with its mass energy. This indicates that the mesotron transforms into an electron, in which case the remarkable parallel between the mesotron and the Yukawa particle is taken one stage further. In terms of Yukawa's theory, the phenomenon observed may be described as a disintegration of the mesotron with the emission of an electron, thus constituting the most elementary form of β-disintegration.

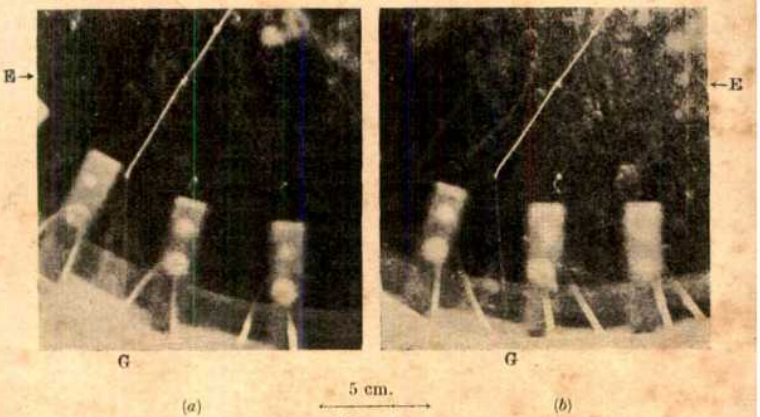

Fig. 2.

a AND *b* ARE ARRANGED FOR STEREOSCOPIC OBSERVATION WITH THE NAKED EYE, WHEN USUALLY THE LEFT EYE SEES THE RIGHT-HAND PICTURE.

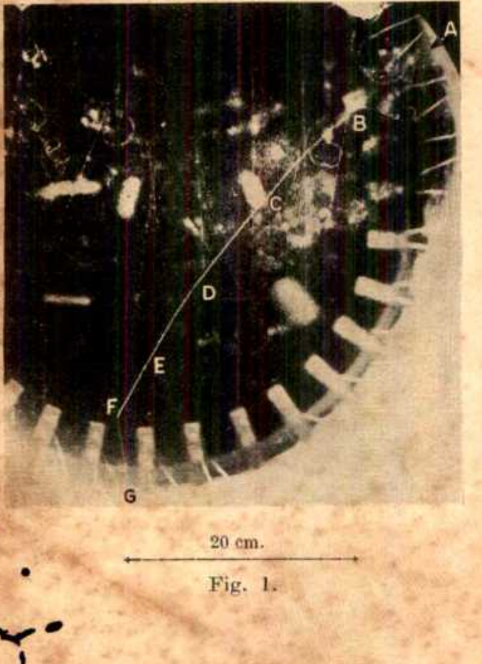

Fig. 1.

Fig. 1 is a reproduction of one of the photographs of the stereoscopic pair. The dense track *AF* is that of the mesotron, and the faint track *FG* leaving its end, near the bottom of the chamber, is that of the fast electron. It will be noticed that the latter is comparable in density with the tracks of other fast particles which happened to traverse the chamber in the same region. Fig. 2 is a larger reproduction of the stereoscopic pair, showing only the end portion of the mesotron track and the emergent electron (2*a* is not in as good focus as 2*b*). Fig. 3 is a heavily exposed reproduction of the last few millimetres of the mesotron track to bring out its shape though the electron track is thereby nearly lost, and Fig. 4 is an enlargement of the δ-track at *E* to show more clearly its initial direction. The tracks in the present reproductions are much less distinct than in the original negatives and photographic prints, and this particularly applies to the fast tracks (including

FG) and the short δ-tracks, of which there are at least six obvious ones to be seen between *C* and *F* on the original negative.

That the dense track is that of a mesotron follows from its range and curvature, and from the δ-tracks. An accurate estimate of the mass from the curvature is not possible because the scattering which the particle suffers interferes appreciably with the curvature due to the magnetic field. The straightness of *FG* and of neighbouring fast tracks shows that there was no appreciable distortion from air motion. The radius of curvature, ρ, at *B*, measured over *AC* (~ 20 cm.), is 70 cm., giving $H\rho = 1180 \times 70 = 8\cdot3 \times 10^4$. The range beyond *B* is 33 cm. in the chamber, corresponding to 41 cm. of normal air. These data give a mass, μ, of $(250 \pm 70)\ m$, where m represents electronic mass. This is of the same order as previous estimates of the mass of the mesotron, and is sufficiently far removed from the mass of the proton (1840 m) to establish the particle as a mesotron. The number and range of the δ-tracks also indicate mesotronic mass, and rule out a proton. In particular the long δ-track at *E*, which in the reproduction in Fig. 3 is seen to be directed nearly forward, has a path-range, R', equal to $0\cdot06 \pm 0\cdot03$ times the remaining range, R, of the heavy particle. This is roughly the range that would be expected for a secondary electron knocked nearly forward by a mesotron with the observed remaining range. It is, however, at least five times greater than the range of the longest δ-track that could be produced by a proton. The latter is approximately $(2^{3\cdot4}/1840)R = 0\cdot006R$. Regarding the 'scattering' of the track, while it is more pronounced than the *average* effect expected for a mesotron, it is more compatible with the latter than with a proton or any other known particle. The natural 'curvature' of cloud-tracks due to multiple and single scattering is discussed by one of us in a paper now in the press (*Physical Review*). It is there shown that towards the end of its range—last 5 cm. or so—the natural curvature of a mesotron track may well exceed its magnetic curvature in a field of 1,200 gauss. (The 'kink' at *D* contributes little to the average curvature and is possibly more a thinning of the track on one side than a true deflection. The 'single' scattering at *C* appreciably reduces the overall curvature.) The bending of the track in the last 5 mm. or so (Fig. 3) is of interest. It indicates that the mesotron has come to the end of its range, thus discounting the possibility that the photograph represents the production of a mesotron and an electron by a neutral particle. Against this supposition are also the facts that the long δ-track at *E* is initially directed forward, and that the δ-tracks are more numerous in the lower half of the track. Both indicate motion of the mesotron towards *F*.

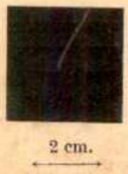

Fig. 3

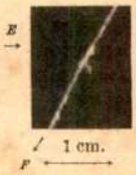

Fig. 4

The curvature of the electron track, *FG*, is very small. Actually there is detectable (Fig. 2*b*), a small curvature in a direction indicating a positive charge, which is also the direction of the curvature of the mesotron. The photograph thus represents a positive mesotron transforming into a positive electron. So far as it can be estimated, the radius of curvature of *FG* is 200 cm. ± 50 per cent, which in the field of 1180 gauss (neglecting any distortion due to air-motion) indicates an energy of 70 Mev. ± 50 per cent. Taking $\mu = 200\ m$, and assuming that a neutrino takes half the energy, the energy of the electron would be 100 $mc^2 = 50$ Mev.

The large energy of the electron shows, quite apart from Yukawa's theory, that mass has been annihilated—for the mesotron, even if we suppose it has disintegrated before 'stopping', has certainly less than 4 Mev. of kinetic energy. Actually, the large bending of the end of the mesotron track indicates (as already pointed out) that *E* is the normal end of its range, where it has reached too low a velocity to ionize further. In this connexion it is of interest that an upper limit to the lifetime, τ, of this mesotron, since its entry into the chamber, can be set from the fact that the electron track starts from a point certainly not more than 0·4 mm. from the end of the mesotron track. Assuming the mesotron, after it ceases to ionize, to diffuse with gas-kinetic free path (10^{-5} cm.) and thermal velocity (10^6 cm./sec.) this gives an upper limit to τ of $(0\cdot04^2/10^{-5} \times 10^6) \sim 2 \times 10^{-4}$ seconds. Actually it is likely that a mesotron, when it stops ionizing, has a velocity of at least 10^7 cm./sec., and a free path considerably greater than gas-kinetic values, so that τ must be much less than the above limit. The average value of τ deduced from the anomalous absorption of cosmic ray mesotrons is of the order of 10^{-6} seconds.

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Large Cosmic Ray Showers and Mesons

IT has been pointed out recently by Bhabha, Carmichael and Chou[1] that a meson may produce a large cosmic ray shower by knocking on an atomic electron in a close collision; this electron then produces a shower by the ordinary cascade process. Previously, Bhabha[2] had come to the conclusion that large knock-on showers are comparatively unimportant; but he had based his argument on the assumption that the scattering of mesons by electrons could be described by the Dirac relativistic theory. However, Massey and Corben[3] have shown that the effect of the spin of the meson is greatly to increase the scattering for high energies of the incident meson and the knocked-on electron. Using Massey and Corben's formula, Bhabha, Carmichael and Chou have shown that the experimental results of Carmichael and Chou[4] can be reasonably well explained, whereas the previous theory predicted too few large showers.

There is, however, another process which has to be considered. In passing a nucleus, a meson may emit a very hard γ-ray, and this γ-ray will start a cascade shower. Since γ-rays and electrons are about equally efficient in producing showers, it is only necessary to consider the relative magnitude of the cross-sections for knocking-on an electron and producing a γ-ray of the same energy, and it appears from calculations which we have recently carried out that at sufficiently high energies the production of a γ-ray is the more probable process.

The direct calculation of the radiation loss by mesons is distinctly complicated. We have, therefore, used the method of impact parameters employed by v. Weizsäcker and by Williams for discussing the corresponding electron problem. This method requires a knowledge of the scattering cross-section for light quanta by mesons which are initially at rest. We have calculated this, using Kemmer's new matrix formulation of the meson equations[5], which is particularly well adapted to the treatment of problems not involving the nuclear interaction. We have then used this formula, which is too complicated to be quoted here, to obtain the radiation loss in the extreme relativistic case. We find that the differential cross-section for the process in which a meson of energy E collides with a heavy nucleus of atomic number Z and emits a γ-ray the energy of which lies in the range εE, $(\varepsilon + d\varepsilon)E$, is

$$\frac{1}{137}\,\frac{Z^2}{12}\left(\frac{e^2}{mc^2}\right)^2\frac{E}{mc^2}\,(2-2\varepsilon+7\varepsilon^2)d\varepsilon, \qquad (1)$$

where m is the mass of the meson. (This formula does not apply to very small values of ε.)

The corresponding cross-section for the knock-on process in which the meson gives up a fraction ε of its energy to one of the Z atomic electrons is

$$\frac{\pi}{3}Z\left(\frac{e^2}{mc^2}\right)^2(2-2\varepsilon+\varepsilon^2)\frac{d\varepsilon}{\varepsilon}. \qquad (2)$$

Hence, for energies greater than about 300 mc^2/Z, that is, about 4×10^9 ev. for air and about 4×10^8 ev. for lead, the emission of a γ-ray is the more probable process. It is, therefore, clear that the calculations of Bhabha, Carmichael and Chou must be modified; the revised theory will give an even greater number of large showers.

It is also of interest to compare (1) with the corresponding formula for electrons, which according to v. Weizsäcker is, with sufficient accuracy,

$$\frac{4Z^2}{137}\left(\frac{e^2}{m_ec^2}\right)^2\log\frac{137}{Z^{\frac{1}{3}}}\left[\frac{4}{3}(1-\varepsilon)+\varepsilon^2\right]\frac{d\varepsilon}{\varepsilon}, \qquad (3)$$

where m_e is the electronic mass. We see that in spite of the much larger mass of the meson, the cross-section for the emission of a very energetic γ-ray (for which $\varepsilon \sim 1$) is greater for mesons than for electrons, provided that the energy is greater than about $3 \times 10^{13} \log (137Z^{-\frac{1}{3}})$ e.v. Similarly, we can conclude that a γ-ray with energy greater than about 10^{14} ev. is more likely to produce a meson pair than an electron pair, provided of course that the electron theory and the meson theory both remain valid in this region. As a consequence of this we may expect to find cascade showers consisting mainly of mesons and γ-rays high up in the atmosphere. As the energies of the individual particles diminish, the number of mesons will decrease, since electrons will be created instead of mesons when the energies of the γ-rays fall appreciably below 10^{14} ev.

Full details of the calculations will be published when circumstances permit.

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Series in Nuclear Energy-Levels

P. G. Kruger, F. W. Stallmann and W. E. Shoupp[1], investigating the γ-spectrum and the spectrum of the emitted neutrons of the reaction ${}^{9}_{4}\mathrm{Be} + {}^{2}_{1}\mathrm{D} \rightarrow {}^{11}_{5}\mathrm{B} \rightarrow {}^{10}_{5}\mathrm{B}^* + {}^{1}_{0}n \rightarrow {}^{10}_{5}\mathrm{B}$, have found a system of excitation energy-levels of the nucleus ${}^{10}_{5}\mathrm{B}$ with the values 0·26; 0·50; 0·61; 1·44; 1·93; 2·92; 3·64 and 4·73 Mev., which they interpret as ${}^3D_{1,2,3}\ {}^1S\,{}^1D\,{}^3D\,{}^1D\,{}^3F$ levels.

It is worth remarking that the second, fourth, sixth and eighth terms can be represented by the formula $E_K = 0{\cdot}239\ K(K + 1)$ Mev., with $K = 1;\ 2;\ 3;\ 4$; that is, 0·478; 1·434; 2·868 and 4·780 Mev. (by the method of least squares), the deviation of the experimental data being much smaller than the error of 5 per cent admitted by the authors. The formula above corresponds to the law of terms of the rigid rotator in quantum mechanics $E_K = K(K + 1)\hbar^2/2J$, where K is the angular quantum number and J is the moment of inertia.

Also, the ratio of the third and the seventh term being 1 : 6 fits surprisingly well into the scheme above with $K = 1$ and $K = 3$. In consequence, we should expect a further term with $K = 2$; and there is such a term (the fifth) at 1·93. The method of least squares leads to 1·84 Mev., just within the limit of the error admitted by the authors, and to $E_K = 0{\cdot}307\ K(K + 1)$ Mev., with $K = 1;\ 2;\ 3$. The moments of inertia are then $J_1 = 1{\cdot}45 \times 10^{-48}$ and $J_2 = 1{\cdot}13 \times 10^{-48}$ gm.cm.^{2}. Inserting the mass of ${}^{10}\mathrm{B}$, we can calculate a lower limit of the radius of the rotating nucleus to be $r > 2{\cdot}6 \times 10^{-13}$ cm., which appears a reasonable value. With spherical distribution of the particles ($J = \frac{2}{5}Mr^2$), we get $r_{\mathrm{sph.}} = 4{\cdot}15 \times 10^{-13}$ and $4{\cdot}71 \times 10^{-13}$ cm. respectively. That we find two different moments is due either to isomerism of the nucleus ${}^{10}_{5}\mathrm{B}$ or to a non-spherical symmetry of the nucleus. Thus all terms equal to or greater than 0·48 Mev. of ${}^{10}_{5}\mathrm{B}$ can be represented as terms of the rigid rotator, and the law is confirmed with eigen values 10^{10} times as great as in molecules.

The term law of the rotator can be applied also to other nuclei. For example, in ${}^{26}\mathrm{Mg}$, excitation levels are known[2] at 2·3, 4·0 and 5·0 Mev. With $E_K = 55{\cdot}5\ K(K + 1)$ kv., $K = 6;\ 8;\ 9$; we get 2·33; 4·00 and 5·00 Mev. For the moment of ${}^{26}\mathrm{Mg}$ we find $6{\cdot}25 \times 10^{-48}$ gm.cm.^{2}, $r_{\mathrm{sph.}} = 6{\cdot}06 \times 10^{-13}$ cm.

Even for nuclei as heavy as ${}^{223}\mathrm{Ac}X$, the law of rotation holds and provides a description of the energy levels. Analysing the α-rays of ${}^{227}\mathrm{RaAc}$, S. Rosenblum[3] has found levels at 30; 61; 81; 135; 174; 197; 235; 247; 288; 313; 335; 386 kv. (some other very feeble ones are not yet determined exactly). With the formulæ $E_K = 1{\cdot}496\ K(K + 1)$ kv. and $E_K = 1{\cdot}594\ K(K + 1)$ kv., using least squares, we get corresponding levels at 29·9; 62·8; 83·6; 134·6; 175·3; 197·5; 233·2; 248·7; 290·1; 314·2; 334·7; 382·6 kv. These levels are also in conformity with the experimental data of γ-rays. In particular, we find for the highest term:

382·6 — 334·7; 233·2; 210·4; 62·8; 29·9 kv.
differences 47·9; 149·4; 172·2; 219·8; 352·7 kv.

γ-Rays are measured with
47·9; 149·2; 172·7; 219·4; 353·0 kv.

The moments of ${}^{223}\mathrm{Ac}X$ come out to be $J = 2{\cdot}18 \times 10^{-46}$ and $J = 2{\cdot}32 \times 10^{-46}$ gm.cm.^{2}

respectively; the radii $r_{\text{sph.}} = 1{\cdot}22 \times 10^{-12}$ and $1{\cdot}26 \times 10^{-12}$ cm. respectively.

In accordance with the assumption of equal density, the $\frac{2}{3}$ powers of the mean values of the moments of inertia of the three atomic nuclei described above are proportional to the atomic weight within 1 per cent, namely, 10 : 26 : 223.

A more detailed discussion and the application to other nuclei will be published elsewhere.

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Wave-length Effect in the Reaction of Human Skin to X- and Gamma-Radiation

THE quantitative variation with wave-length of the reaction of human skin to X- and γ-radiation is of both clinical and biological importance. Of especial interest is the determination of the ratio of the biologically equivalent doses, appropriately measured in röntgens, of X-radiation of effective wave-length 110–170 X.U. and of γ-radiation of wave-length 10–20 X.U. It is an accepted clinical observation that the dose of X-radiation equivalent in the production of skin erythema to 1 r. unit of γ-radiation is less than unity, and recent work[1] suggests a value of the order 1/1·3. However, in this and most other studies, the depth dose distribution was very different for the two radiations.

During a clinical investigation with another object, I have examined the skin reactions produced by γ-radiation in which the depth dose at 0·5 cm. was 97–108 per cent; this distribution was attained during the treatment of cases of carcinoma of the lip, by means of two-plane moulded applicators. Routine X-ray therapy has made comparison possible and ten of the γ-ray cases were selected together with ten suitable cases receiving X-radiation of approximate effective wave-length 145 X.U. In both groups, the end-point observed was the onset of moist desquamation and the overall time of irradiation was 192 hours. The dosage rates were 0·906–1·26 r./min. for γ-radiation and 28·0–31·5 r./min. for X-radiation; in the former case, the intervals between the exposures were never greater than 12 hours; but in the latter, two 48-hour intervals occurred together with the usual 24-hour intervals. Recent experiments[2,3] show that these differences in dosage rate and time spacing produce an error not greater than 5 per cent in the required ratio. The X-ray apparatus was calibrated using a rice phantom and a Victoreen dosimeter, and the measurements were kindly checked by Dr. D. E. Lea using a free air ionization chamber. The γ-ray intensities were calculated assuming that 1 Imc. hr. = 8·4 r., and the homogeneity of the field at the skin was checked photographically. Clinically similar reactions were observed, among these twenty selected cases, with X-radiation with a mean dose 4,250 r. (minimum 4,200 r., maximum 4,500 r.) and with γ-radiation with a mean dose 5,790 r. (minimum 5,490 r.; maximum 6,500 r.); the reaction did not occur with γ-ray doses 5,200 and 5,350 r. From the results, it is concluded that 0·7–0·8 r. unit of X-radiation of effective wave-length 145 X.U. is equivalent, in the production of moist desquamation of normal human skin, to 1 r. unit of γ-radiation of effective wave-length 15 X.U.

It is important to know whether this result is capable of quantitative explanation in terms of the contribution from photo-electric absorption in the heavier elements present, including the sulphur of the stratum corneum. Tedious but straightforward calculations, including once-scattered radiation, show that the 'physical erythemal effectiveness' W_λ, for radiation of primary wave-length λ, which is defined as proportional to the ratio of the energy absorptions per unit volume in tissue at depth $z \approx 0{\cdot}1$ mm. and in a small air cavity at $z = 0$ half embedded at the surface of a phantom, is given by:

$$W_\lambda = k\frac{(\tau+\sigma_a)_{\text{tissue}}}{(\tau+\sigma_a)_{\text{air}}}e^{-[\mu_c z_c + \mu\ (z-z_c)]}\left\{1+K(\lambda)\right\},$$

where k is an arbitrary constant, τ and σ_a respectively the photo-electric and scattering absorption coefficients at λ, μ_c the absorption coefficient and z_c the thickness of the stratum corneum and μ the absorption coefficient of the subjacent tissues. $K(\lambda)$ is a slowly varying function of λ and is ≤ 3 per cent for λ = 145 X.U. This equation has been tested by calculating the value of $\frac{(\tau+\sigma_a)_{\text{tissue}}}{(\tau+\sigma_a)_{\text{air}}}$ for a large number of possible (and improbable!) tissue and nuclear compositions[4,5] using Sauter's formula to obtain τ.[6] From the results, the conclusion must be reached that these physical considerations cannot possibly lead to a value of the ratio less than 0·9, which is significantly greater than that observed.

In seeking an explanation in terms of a chemical process, the participation of excited molecules[7] appears to be supported by the similarity of the photo-chemical changes produced in certain organic compounds by ultra-violet and X- and γ-radiations[8]. Further, the theoretical possibility of a small wave-length effect, but in the opposite direction to that observed, is introduced by the work of Bethe[9], who showed that during the passage of fast electrons through atomic hydrogen the ratio of the probabilities of excitation to ionization processes increased slowly with the energy of the electron. The similarity of the values of the ionization and excitation potentials[10] suggests that the effect may be of the same order for water as for hydrogen. Calculations on this basis (including secondary processes) show that in water the ratio of the number of excitation to ionization processes for radiation of wave-length 12·1 X.U. is $\leq 1{\cdot}05$ times the value for the wave-length 121 X.U.; hence this effect is not likely to be of importance.

These considerations suggest that the observed response of human skin to X- and γ-radiations cannot be attributed quantitatively to its exceptional histological and chemical structure alone, as appears to be the case for the wave-length effect with ultra-violet radiation[11], and it is worthy of note that similar values of the ratio discussed are suggested by recent work on other living cells, assuming that 1 Imc. hr. = 8·4 r.; for example, 0·65 for Drosophila eggs[12], 0·73 for Drosophila pupæ[13]. Comparison of the ratio for normal and neoplastic tissues would be of great radio-therapeutic interest.

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Cozymase in Adrenalectomized Rats

DURING recent years, Verzár and his co-workers have tried to demonstrate that the adrenal cortical hormone plays an important part in the phosphorylations of the body. They have, among other facts supporting this hypothesis, shown that lactoflavine has no B_2-effect in adrenalectomized rats. In these, however, the full vitamin effect is obtained by lactoflavine-phosphate[1]. They have further shown that in adrenalectomized rats the liver contains abnormally small amounts of fixed lactoflavine[2].

In view of these findings, we have thought it of interest to investigate whether the metabolism of cozymase, another prosthetic group carrying the PO_4 group at quite a different position from that of lactoflavine, is influenced by adrenalectomy.

White rats weighing 100–250 gm. were used. They were kept on a diet of white bread and milk. The adrenals were removed transperitoneally under light ether anæsthesia with aseptic precautions. In some cases the gastrocnemius muscle of one side was removed simultaneously and treated as described below. When the animals were killed by decapitation after about 120 hours, they were with a few exceptions markedly adynamic. The organs were rapidly removed and placed directly upon a block of carbon dioxide 'ice'. They were weighed and minced in the frozen state. About 1 gm. of tissue was heated in 5 c.c. water just to the boiling point and then allowed to cool at room temperature. It was then kept in the ice-chest. Cozymase was determined in the supernatant fluid by the fermentation test with apozymase in Warburg vessels. The apozymase was standardized with a solution of almost pure cozymase (90–100 per cent).

Controls			Adrenalectomized		
Body weight (gm.)	Weight of brain (mgm.)	Cozymase (γ per gm. brain)	Body weight (gm.)	Weight of brain (mgm.)	Cozymase (γ per gm. brain)
♂ 187	1455	156	♂ 195	1188	94
♂ 202	1154	142	♀ 92	1199	126
♂ 215	1380	119	♂ 217	1320	144
♂ 220	1585	141	♂ 165	1317	151
♂ 160	1183	150	♂ 165	1320	106
♀ 125	1085	115	♂ 145	1255	139
♂ 175	1234	132	♂ 132	1339	87
♂ 195	1343	133			
♂ 202	1401	128			
♂ 245	1388	138			
♀ 123	1244	183			
		Mean 140			Mean 121

Experiments with a few animals failed to show any difference between adrenalectomized and control rats in the cozymase content of heart, liver, muscle and kidney. There appeared, however, to be a marked increase of cozymase content of the brain after adrenalectomy. That this was only accidental is shown by the accompanying table giving the values obtained in a series of 11 normal and 7 adrenalectomized rats. The cozymase content is given in γ cozymase per gm. fresh weight. The difference between the means is obviously not significant.

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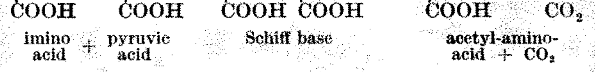
Mechanism of Enzymic Decarboxylation

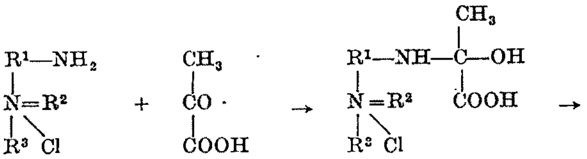
A THEORY of the mechanism of the enzymic decarboxylation of pyruvic acid is suggested, which, though not yet capable of strict experimental proof, is consistent with many recent observations.

Langenbeck[1] predicted the amine nature of cocarboxylase. He showed with various amines serving as carboxylase models that the first step of the catalysis is the formation of a Schiff base. Schiff bases have been postulated as intermediaries in several biological reactions, such as transamination[2] and synthesis of amino-acids[3-6], in the course of which they undergo intramolecular oxido-reductions. Of special interest, because it involves a decarboxylation of pyruvic acid, is the following mechanism of amino-acid synthesis originally proposed by Knoop[3,4] and experimentally corroborated by the recent work of du Vigneaud *et al.*[5,6]:



In this scheme pyruvic acid acts as hydrogen donator for the imino acid, being itself oxidized to acetic acid and carbon dioxide.

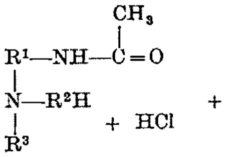
Besides possessing a free amino group, cocarboxylase contains pentavalent nitrogen which is capable of reduction[7]. The initial steps of decarboxylation may therefore be pictured by the following reactions involving an intramolecular oxido-reduction of the Schiff base primarily formed:



$$\begin{array}{l} R^1\text{—}NH_2 \\ | \\ N{=}R^2 \\ |\diagdown \\ R^3\ \ Cl \end{array} + \begin{array}{c} CH_3 \\ | \\ CO \\ | \\ COOH \end{array} \rightarrow \begin{array}{l} \qquad\qquad\ \ CH_3 \\ \qquad\qquad\ \ | \\ R^1\text{—}NH\text{—}C\text{—}OH \\ | \qquad\qquad\ | \\ N{=}R^2 \quad\ COOH \\ |\diagdown \\ R^3\ \ Cl \end{array} \rightarrow$$

cocarboxylase + pyruvic acid (I)

Schiff base (II)

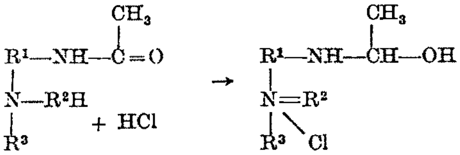


$$\begin{array}{l} \qquad\qquad\ CH_3 \\ \qquad\qquad\ | \\ R^1\text{—}NH\text{—}C{=}O \\ | \\ N\text{—}R^2H \qquad\qquad + \ CO_2 \\ | \qquad + \ HCl \\ R^3 \end{array}$$

acetyl-dihydrococarboxylase

(III)

Although the decarboxylating systems of yeast and animal tissues possess the same coenzyme, they differ in that the former converts pyruvic acid into carbon dioxide and acetaldehyde, whereas the latter, in common with certain bacteria, form carbon dioxide and acetic acid by an oxidative mechanism. On the basis of the proposed mechanism a natural explanation is possible if we assume that in animal tissues compound (III) is dehydrogenated to acetyl-cocarboxylase only by a specific carrier[8], whereas in yeast a second intramolecular oxido-reduction occurs resulting in the Schiff base of acetaldehyde (IV):



$$\begin{array}{l} \qquad\qquad\ CH_3 \\ \qquad\qquad\ | \\ R^1\text{—}NH\text{—}C{=}O \\ | \\ N\text{—}R^2H \\ | \qquad + \ HCl \\ R^3 \end{array} \rightarrow \begin{array}{l} \qquad\qquad\ CH_3 \\ \qquad\qquad\ | \\ R^1\text{—}NH\text{—}CH\text{—}OH \\ | \\ N{=}R^2 \\ |\diagdown \\ R^3\ \ Cl \end{array}$$

(III) (IV)

Besides accounting for the difference between yeast and animal carboxylase, the scheme outlined above is capable of explaining various other facts. It has been observed that acetic acid is very slowly metabolized by isolated animal tissues, yet it has been shown to be formed by the decarboxylation of pyruvic acid which is metabolized very vigorously. An 'active form' of acetic acid has therefore been postulated[9] which can be rapidly metabolized, probably by way of condensations leading to succinic, citric and acetoacetic acids. It is suggested that this 'active form' is identical with acetyl cocarboxylase.

It has recently been reported by Quastel and Webley[10] that the ability of propionic acid bacteria to oxidize acetic acid is greatly enhanced in presence of vitamin B_1. This can be explained by the assumption that this organism possesses the faculty of synthesizing the 'active form' of acetic acid, namely, acetyl cocarboxylase, from acetic acid and cocarboxylase.

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The Releaser Concept in Bird Behaviour

LORENZ[1] has provided a wealth of data and analysis to show that many instinctive acts in birds are 'released' not by the external situation as a whole, but by some characteristic part of it. This greatly assists in explaining the evolution of plumage patterns and rhythmical movements in display in birds, particularly with regard to their 'improbable' and specific nature.

Recent work[2] on the British robin (*Erithacus rubecula melophilus* Hartert) suggests modification of the releaser concept. First, there is the obvious point (with which presumably Lorenz would agree) that the internal state of the bird must also be considered. Thus the copulatory behaviour of the male robin is released when the female assumes a characteristic flattened attitude. But sometimes the male does not copulate when the female assumes this attitude, and sometimes he tries to copulate without the female assuming this attitude; the former can be accounted for by an exceptionally weak, the latter by an exceptionally strong, copulatory drive in the male at the time.

The robin attacks all other robins intruding in its territory, and analysis of the external situation releasing this aggressive behaviour well illustrates Lorenz's point that a characteristic pattern can be the most important factor involved. For a mounted specimen of a robin lacking the red colouring on the breast was attacked much less often than a specimen reduced to just a bundle of red breast feathers and lacking head, wings, legs and back. However, analysis showed that no single factor releases aggressive behaviour, for the robin at times attacks (1) various other species of birds of most diverse coloration, chiefly in flight; (2) a mounted robin lacking red on the breast; (3) a bundle of red breast feathers: which three objects have no factor in common. Further analysis showed that the aggressive behaviour could be divided into three main reactions: (1) pursuit-flight, primarily elicited by a small bird flying away; (2) direct striking, primarily elicited by a stationary bird of approximately robin-shape (the presence or absence of red on the breast being unimportant); (3) threat-posturing, primarily elicited by a red breast. Hence the facts could almost be reconciled with the releaser concept provided that the aggressive behaviour was separated into three reactions, each with its own releaser. However, further work showed that this separation, while it undoubtedly existed, was only a tendency, and not a complete division, for, rarely, a mounted red breast was struck and a specimen lacking red on the breast was postured at.

Hence, at least in this case, the releaser concept is too simple. The general implications are important, for they suggest that releasers are not the fundamental units of bird behaviour. Rather, the bird reacts originally to a more general situation. At a later stage (later in evolution if the releasing complex is inherited, later in the life of the individual if it is acquired: this issue is not discussed here), the bird tends to react primarily (but not necessarily exclusively) to a characteristic part of the external situation. The characteristic part or pattern may then appear to 'release' the behaviour concerned; but it is not (at least always) the sole factor which will elicit the behaviour.

On the above view, releasers are considered to be specialized and secondary. The ability of birds to evolve releasing complexes is clearly of value to the species, and this modification of the concept in no way diminishes the importance of Lorenz's arguments on the nature and evolution of display patterns in birds, since it is agreed that a particular pattern is often the most important (though not necessarily the sole) factor eliciting a particular train of behaviour.

The robin's own mate apparently possesses all the main factors eliciting aggressive behaviour but is attacked extremely rarely and only mildly. This and other facts discussed in the paper cited show the complexity of the problem, which I have been unable to reconcile with any theory of behaviour. The partial separation of the behaviour into particular stimuli with particular responses suggests a mechanistic rather than a holistic interpretation; but the incompleteness of the separation shows a simple mechanistic interpretation to be inadequate.

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Dec. 27.

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[1] Lorenz, K., *J. Orn.*, **83**, 137–213, 289–413 (1938); *Auk*, **54**, 245–273 (1937).

[2] Lack, D., *Proc. Zool. Soc.*, A, **109**, 200–216 (1939).

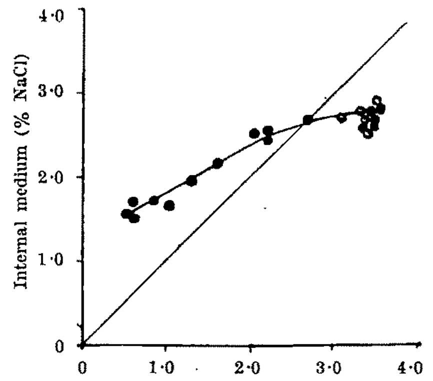
Osmotic Properties of the Common Prawn

IN a previous communication[1] I referred to the homoiosmotic behaviour of *Palæmonetes varians* and its ability to maintain hypotonicity in normal sea water. Further experiments on the osmo-regulatory mechanism of some Crustacea have revealed that the common prawn, *Leander serratus* (Pennant), is also definitely hypotonic when in normal sea water.

The blood of this prawn when taken from sea water has an osmotic pressure equivalent to 2·6–2·9 per cent sodium chloride, the difference between the external and internal media being round about 0·7 per cent. This osmotic pressure is more or less retained by the animals up to dilutions of about 2·5 per cent in the external medium; but in lower dilutions there is a steady decline. In laboratory experiments 0·5–1·0 per cent was the lowest range of salinities at which the prawns could live; and an osmotic pressure equivalent to that of 1·3–1·6 per cent sodium chloride would seem to be the minimum internal osmotic pressure compatible with life.

Compared with Palæmonetes, Leander has a higher osmotic pressure when in normal sea water, and the ability to maintain the osmotic pressure of the blood near the optimum is also much less developed in Leander, as may be seen from the accompanying graph. The difference between the highest and lowest values for the blood of Leander in different dilutions is nearly 1·5 per cent, while the corresponding difference for Palæmonetes is only 0·5 per cent.

Studies on the rate of change of osmotic pressure when prawns are put in dilute sea water have shown that the reduction of the internal osmotic pressure goes on steadily and slowly during the first 14–24 hours, but after the lowest value has been reached there is a slight rise. It is worthy of note that the rate of change of osmotic pressure is different in individuals of different sizes. Young prawns 45–65 mm. long respond to external osmotic changes more speedily than larger ones. The ability to live with a low osmotic pressure of the internal medium is also more pronounced in them than in full-grown individuals.



RELATION BETWEEN THE OSMOTIC PRESSURE OF BLOOD AND THE EXTERNAL MEDIUM OF *Leander serratus*.
Values in per cent sodium chloride. Abscissæ, sea water; ordinates, blood. Straight line indicates where points would fall if blood and medium were isotonic.

Leander serratus is a littoral species abundant in the southern parts of the North Sea and in the Mediterranean[2]. Though it is able to live in places where the salinity is slightly lower than that of the sea as observed at Plymouth, its habitat is essentially marine; but the osmotic behaviour of *L. serratus* is most unusual for a marine invertebrate. It is of great interest, since certain prawns like *Leander longirostris* M. Edw. are known to migrate many miles up rivers[2] and many tropical species are known to be typical brackish-water and freshwater inhabitants[3]. If the osmotic properties of *Leander serratus* are shared by other species (and it seems very likely), it would explain their peculiar habits and distribution. The physiological evidence would seem to be in favour of considering this species of Leander as having taken secondarily to marine life, since its osmotic behaviour is so unlike that of most other marine invertebrates that have developed powers of osmo-regulation.

N. KESAVA PANIKKAR.

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Plymouth.
Dec. 11.

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[1] Panikkar, N. K., NATURE, **144**, 866 (1939).

[2] Gurney, R., *Proc. Zool. Soc. London*, 97 (1923).

[3] Kemp, S., *Rec. Ind. Mus.*, **27**, 287 (1925).

Utilization of Nitrogen by *Ophiobolus graminis*

THE survival period of the fungus *Ophiobolus graminis*, causing the 'take-all' disease of wheat, in infected wheat straw buried in the soil is increased by the application of nitrogen in such forms as calcium nitrate, ammonium nitrate, ammonium sulphate, ammonium carbonate, and dried blood[1,2]. I have recently suggested[2] that these sources of nitrogen are directly utilized by *O. graminis*, which is thereby enabled to decompose more of the carbohydrate material of the straw, and hence to prolong its existence. Fellows has claimed[3], however, that *O. graminis* is unable to utilize nitrates or ammonium salts, and can assimilate nitrogen only in certain organic forms. His claim is invalidated by the experiments of Padwick[4], using a very similar synthetic medium to that employed by Fellows, but with the addition of a growth-promoting factor. In the presence of a growth-promoting extract obtained from carrots, growth of *O. graminis* was increased four-fold by the addition of 0·15 per cent of nitrogen as sodium nitrate to the medium.

The results of a recent experiment here support those of Padwick. 6-gm. portions of chaffed wheat straw were bottled with the addition of 24 ml. of water or calcium nitrate solution. The calcium nitrate series received 0·25 gm. of nitrogen per 100 gm. air-dry straw. The bottles were plugged and autoclaved for 30 minutes at 15 lb. pressure on three successive days, inoculated with a pure culture of *O. graminis*, and incubated at 25° C. The loss in dry weight in the two series with and without additional nitrogen was as follows (each determination is a mean derived from three bottles):

	Percentage loss in dry weight (oven-dry basis)	
	After 3 months	After 6 months
No additional nitrogen	21	28
With 0·25 gm. nitrogen as calcium nitrate	27	33

Determinations of nitrate nitrogen in the calcium nitrate series, kindly made for me by Mr. R. G. Warren, of the Department of Chemistry, were as follows:

Sterilized but not inoculated control—240 mgm. nitrate nitrogen per 100 gm. air-dry straw.

Inoculated and incubated for 3 months—13 mgm. nitrate nitrogen per 100 gm. air-dry straw.

Inoculated and incubated for 6 months—0 mgm. nitrate nitrogen per 100 gm. air-dry straw.

These results show that a pure culture of *O. graminis* growing on sterilized wheat straw can utilize nitrate nitrogen, and hence support the conclusions of Padwick[4].

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Dec. 20.

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[1] Garrett, S. D., *Ann. Appl. Biol.*, **25**, 742 (1938).
[2] Garrett, S. D., *Ann. Appl. Biol.*, in the press.
[3] Fellows, H., *J. Agric. Res.*, **53**, 765 (1936).
[4] Padwick, G. W., *Sci. Agric.*, **16**, 365 (1936).

Occurrence of Some Off-shore Amphipods in the Littoral Zone

IT has been pointed out by various investigators that *Echinus esculentus* L., an animal usually confined to off-shore waters, is found in some places in the littoral zone. Reid[1] showed that it occurred intertidally only on those coasts washed by the North Atlantic Drift, while elsewhere it was confined to deeper waters.

During a period of collecting in August at Oldany Bay Harbour, near Drumberg, Sutherland, *Echinus esculentus* was found intertidally. But it is of interest to note that the following amphipods were also found above low water of spring tides beneath stones and in algæ (Dictyosiphon sp.).

Gammaridea: *Ampelisca spinimana* Chevreux, *Harpinia antennaria* Meinert, *Leucothöe spinicarpa* (Abildg.), *Coremapus versiculatus* Norman.

Caprellidea: *Phtisica marina* Slabber, *Caprella acanthifera* Leach.

A search of the literature has so far shown that, with two exceptions, these amphipods have only been recorded in deep water or below the tidal zone. The two exceptions are *C. versiculatus* and *C. acanthifera*, and it is significant that these records are from the Clyde area and Lough Ine, both of which regions are bathed by Atlantic water. This discovery is of interest and suggests that the phenomenon shown by Echinus may be of a more general character than is supposed. A study of the intertidal distribution of other animal groups round the British Isles might prove of value.

C. B. GOODHART.
RICHARD HARRISON.

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Cambridge.
Dec. 15.

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[1] Reid, D. M., *J. Animal Ecol.*, **4**, 7, (1935).

Scientific and Technical Literature and Information

AMONG the important suggestions made in the editorial in NATURE of November 25 is included the desirability of establishing a new organization which would, among other things, "establish a system of co-ordination among the various provincial libraries of the university and research types". Although it is stated that "the National Central Library is still functioning as a clearing-house for demands for books on loan", it is apparently not realized that this Library is already acting as the national centre for the inter-library lending of books and periodicals, not only between libraries of "the university and research types", but also between libraries of all types, among which must be included our larger public libraries, which frequently contain—and lend—scientific and technical books not available in any other library in the British Isles.

It would appear to be extravagant and unnecessary to set up a new organization to do work which the National Central Library is already doing and for which it has the necessary machinery, even if this is still far from perfect. The service of the Library is used by Government departments, the universities, and almost every library in the British Isles. In normal times it is used also by libraries throughout Europe and elsewhere. The extent of the service is illustrated by the fact that, in addition to the books on its own shelves, the Library has access to more than 21,000,000 books in other libraries in the British Isles. The libraries lending and borrowing through the National Central Library include many of the leading scientific and technical libraries in the country.

It is true, as is stated in the article, that the National Central Library depends upon the Science Library for many books and periodicals—in fact the value of the co-operation of the Science Library cannot be too strongly emphasized—but it is only fair to the other scientific libraries and to the National Central Library's own stock to point out that last year only approximately three per cent of the scientific and technical books lent were obtained from the Science Library.

It is suggested that a union catalogue of war-time holdings of important foreign periodicals should be compiled, but it is not pointed out that, in addition to the entries in many printed union and other catalogues, the National Central Library has tens of thousands of manuscript entries of periodicals in British libraries. This information is constantly being brought up to date.

Experience so far suggests that no great difficulty is likely to arise in buying current numbers of foreign, including German, periodicals through the authorized agents. It may not, therefore, be necessary to establish "a central body" for this particular purpose.

As is now well known, the service of the National Central Library is available to any person, provided that he applies for books through his university, public, or other library, and not directly to the National Central Library.

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THE services provided to the scientific and technical research worker by the National Central Library are too well known to need emphasis in the present emergency. So far as text-books and pre-war volumes of periodicals are concerned, these services will doubtless find increasing utilization during the War. However, the original editorial more specially concerned itself with the supply and use of current issues of scientific and technical periodicals, especially European publications. The only portions of Colonel Newcombe's memorandum that are relative to this specific problem are his statements that the entries in the National Central Library relating to holdings of such periodicals by British libraries are constantly being brought up to date, and his optimism concerning the facilities for obtaining European periodicals at the present time.

Regarding the first claim, it may be true that, from time to time, the entries relating to holdings of periodicals are revised by the libraries concerned, and copies of the revisions incorporated in the archives at the National Central Library. Nevertheless, it is a well-known fact that contributor libraries to union catalogues of holdings are exceedingly dilatory in communicating information that reflects the deficiencies of their stocks, and this is especially true of current volumes. All librarians naturally hope to fill any lacunæ that arise, and hesitate to revise even their own catalogues until the entries are closed up finally. It is quite certain that, unless the urge to revise entries and betray gaps is stimulated by a prospect that the gaps may be filled from some 'pool', librarians will see no reason to notify the National Central Library of the deficiencies in their holdings of current volumes.

As regards Colonel Newcombe's optimism about present facilities for purchasing European periodicals, it is not irrelevant to point out that already the National Central Library has taken the precaution of removing its records to a relatively obscure site, and has thus provided evidence of a dislocation that may have been temporary in some aspects, but is permanent in others. It can scarcely be said to have facilitated the operations of this particular centre. There are, however, many other aspects of this problem of supply. Many libraries have closed down; many others have seen their periodicals, previously obtained by presentation or exchange, come to an abrupt termination in the middle of volumes; most libraries have to economize in their purchases. The effects of these three factors alone will render the National Central Library's union catalogue of doubtful efficacy in regard to holdings of current issues of European periodicals unless drastic revisions are made therein. Finally, we have to consider the possible extension of hostilities to include those neutral countries that are at the moment serving as sources of supply for these periodicals, the effects of intensive hostilities at sea, and the possibility that sooner or later extensive air-raids over Britain may occur.

THE WRITER OF THE ARTICLE.

Archæology in the U.S.S.R.

IT would be a pity if dislike of the Soviet's foreign or domestic politics should lead men of science to take an unduly gloomy view of the position of archæology in Russia[1]. Prof. Tallgren's last visit to the U.S.S.R. coincided with mine in 1935, and since then many changes have supervened, one may hope for the better. For example, in 1936 a new periodical, *Sovietskaya Archeologiya*, better printed and illustrated than its immediate forerunners, began to appear, to make up a little, admittedly inadequately, for the deficiencies in publication which Tallgren deplored.

The editorial in No. 1 might indeed reinforce his apprehensions—"La lutte implacable contre les écrits pseudo-scientifiques fascistes en matière d'archéologie, le dévoilement incessant des falsifications fascistes des faits archéologiques constituent le devoir direct des archéologues soviétiques qui édifient la véritable science objective"; "La lutte sans merci contre les altérations de tout genre du marxisme-léninisme"—and similar sentiments were discouraging. However, the introduction to No. 2 is devoted to a repudiation of the scholasticism No. 1 apparently approved, a rehabilitation of migrations, the typological method and other devices and an elaboration of the theme "Les recherches historiques exigent une étude approfondie, méthodique et objective des sources premières au lieu que le schématisme corrompait la pensée des historiens, les habituant à mépriser les faits".

Far from making a gulf "completely effective against Western archæological thought", the Institute for the History of Material Culture in the Academy of Sciences seems to welcome exchanges with archæological societies in Great Britain and with individuals, including the writer. "Gentile", "pre-class", . . . may be inconvenient categories; I doubt if they are really more deceptive than the terms "neolithic", "Bronze Age" as used in English as late as ten years ago. Prehistoric archæology, being based so largely on a study of tools and weapons, naturally lends itself to a "materialist" interpretation. That does not exclude a study of non-economic activities even in Russia, as for example Zamiatnin's long discussion on fertility rituals in his memoir "Gargarino".

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University, Edinburgh.

[1] NATURE, 144, 971 (1939).

PROF. V. GORDON CHILDE utters a timely protest against "dislike of the Soviet's foreign or domestic politics" leading men of science "to take an unduly gloomy view of the position of archæology in Russia". It was, however, precisely with the view of deprecating any political colouring whatsoever, and of whatever shade of opinion, in scientific matters that protest was made in these columns against the way in which political doctrine under the Soviet Republics had not only affected archæological theory, but had also intervened to check international exchange in scientific research.

Attention was then directed to a specific instance of such interference by which an end has been put to Prof. Tallgren's work—this at a date subsequent to that to which Prof. Childe looks for the appearance of some signs of improvement. Even more abhorrent to the spirit of scientific investigation is the regimentation and even 'liquidation' of the individual, from which archæology, with other sciences, in the U.S.S.R. has suffered severely. This is no question of like or dislike of a political policy as such.

THE WRITER OF THE NOTE.

Points from Foregoing Letters

Evidence, in the form of a cloud-chamber photograph, is given by E. J. Williams and G. E. Roberts for the transformation of mesotrons into electrons. This bears out the supposition that the mesotron is identical with the particle assumed by Yukawa in his theory of nuclear forces and β-disintegration.

A. H. Wilson and F. Booth have calculated the probability that, when a fast meson collides with a nucleus, a very energetic γ-ray will be emitted. They find that the cross-section is proportional to the energy of the meson, and that for very high energies the energy loss is mainly due to the emission of γ-rays. The bearing of this upon the cascade showers in the atmosphere is discussed.

The known nuclear energy levels of ^{10}B, ^{26}Mg and ^{223}Ac*X* are interpreted by K. M. Guggenheimer as eigenvalues of the rigid rotator, which can thus be applied to nuclei. The moments of inertia are in accordance with the assumption of equal nuclear density.

Quantitative clinical observations by J. S. Mitchell, under conditions with equalized depth dose distribution, show that 0·7–0·8 r. unit of X-radiation of effective wave-length 145 X.U. is equivalent, in the production of moist desquamation of human skin, to 1 r. unit of γ-radiation of effective wave-length 15 X.U. Theoretical considerations suggest that this result cannot be attributed entirely to the exceptional histological and chemical structure of skin.

A mechanism for the enzymic decarboxylation of pyruvic acid is proposed by H. Weil-Malherbe involving the formation of a Schiff base from cocarboxylase and pyruvic acid followed by an intramolecular oxido-reduction leading to acetyl-dihydrococarboxylase. It is suggested that this compound is oxidized in animal tissues and in certain bacteria by a specific carrier, whereas it undergoes a second intramolecular oxido-reduction with yeast carboxylase resulting in the formation of the Schiff base of acetaldehyde. Acetyl cocarboxylase may be identical with the 'active form' of acetic acid postulated for animal tissues.

Analysis of aggressive behaviour in the British robin by D. Lack shows that it can be divided into three main reactions, each primarily elicited by a different external factor; but this division is only partial. While colour pattern is particularly important, it is not the sole releasing factor, and, in general, releasers are considered specialized, and not fundamental, units of bird behaviour.

N. K. Panikkar finds that, like Palæmonetes, the common prawn *Leander serratus* is definitely hypotonic when in normal sea water, though it is less homoiosmotic than the former. Its osmotic behaviour is unusual for a typical marine invertebrate and is of interest when the habits of allied species are considered. The osmotic properties would seem to indicate its having taken secondarily to marine life.

S. D. Garrett reports assimilation of nitrate nitrogen by a pure culture of the fungus *Ophiobolus graminis* growing on sterilized wheat straw plus calcium nitrate.

C. B. Goodhart and Richard Harrison report the occurrence of six off-shore species of amphipods in the littoral zone on the north-west coast of Scotland.

War-time co-ordination of library resources, as advocated in a recent issue of NATURE, is discussed by the librarian of the National Central Library. He states that the union catalogue housed in the Library and relating to periodicals in British libraries is subject to continual revision, and that the difficulty of obtaining foreign periodicals in war-time has been exaggerated. In reply to these comments, it is pointed out that revision of entries in union catalogues of periodicals is generally very tardy and imperfect, and that the present period will enhance these imperfections. Reasons are given for anticipating further dislocation and interference with supplies, as compared with peace-time.

RESEARCH ITEMS

New Neolithic Site in Ulu Kelantan, Malaya

THE results of the partial excavation of a rock-shelter at Gua Mĕntĕri on the banks of one of the tributaries of the Sungai Nenggiri have been described by H. D. Noone (*J. Fed. Malay States Mus.*, **15**, 4; 1939). The shelter is about 50 yards in length, 20 yards in height, and of an average breadth under cover of 9 or 10 yards. Two trial trenches were dug, but barely 10 per cent of the area available for excavation was touched. Nevertheless, finds were exceedingly numerous. Except where removal was imperative, they were so far as possible covered in again pending the systematic excavation which the importance of the site demands. It affords stratigraphic evidence for the neolithic period, which is urgently needed; and in the human skeletal remains from the burials it will throw light on the at present obscure problem of the population which carried the neolithic culture into Malaya. The grave goods included pots in rows, and disposed in one instance in threes, one inside the other in the inverted position. The eight complete specimens now recovered are unique as evidence of the character of the neolithic pottery, previously known only from sherds, except for a few complete pots from open sites found without associations or stratification. The trial excavations of two trenches revealed three cultural layers, of which the uppermost at a depth extending to 2½ ft. below red clay was rich in relics of a fully developed neolithic, among which three polished axes were found, preceded, it would appear, by an earlier developmental period. This, in turn, was preceded by a cultural layer of an intermediate character marked by the occurrence of numbers of worked flakes of a black stone, which when struck behaves like flint. The earliest cultural level contained palæolithic implements (Hoabinian). In this three intrusive (neolithic) burials with grave furniture were found, the lowest at a depth of five feet below the red clay. Apart from that associated with the burials this lowest level contains no pottery.

A New Drug for Pneumonia Treatment

THE search for new drugs for combating certain infections continues. A few years ago sulphanilamide was introduced and proved of considerable service in the treatment of sepsis due to the streptococcus, and a couple of years ago sulphapyridine (M. and B. 693) was discovered to be of great value for the treatment of pneumonia, cerebro-spinal fever, and other infections caused by the coccoid group of microbes. It is now announced by Science Service of Washington, D.C. that another drug, sulphathiazole, has been developed in the Squibb Institute for Medical Research, New Brunswick, for the treatment of pneumonia. It is stated that it is even more efficacious against this disease than sulphapyridine, that it is safer and has less toxic effect than the latter.

Control of Puerperal Sepsis

AN important memorandum on this subject has been issued by the Ministry of Health (Memo. 226/Med. H.M. Stationery Office. 2*d*. net). Its object is "to explain the nature of puerperal sepsis, how it is spread, and how to identify and group the streptococci responsible". Actually, little is said about puerperal infection in general, the pamphlet being restricted to infections due to the class of microbes known as hæmolytic streptococci, which, however, do not account for more than half the cases of puerperal infection. Details are given of the sources of streptococcal infection, and of the methods of detecting it in patient, midwife or nurse, and of the procedure to be adopted when a source of infection is detected. Finally, a description is given of the laboratory methods required for the isolation and identification of the hæmolytic streptococcus.

Insects of Greenland

STUDENTS of animal distribution will welcome the recent contribution by Kai J. Henriksen entitled "A Revised Index of the Insects of Greenland". Published in *Meddelelser on Grønland* (**119**, No. 10, 111; 1939), it is obtainable from Messrs. C. A. Reitzels of Copenhagen, price Kr. 5.00. It appears that more than twenty years have elapsed since the last list of Greenland insects was published. During that period both English and Danish collecting expeditions have added materially to what is known of the Greenland insect fauna. The Collembola, for example, have been well studied and now number forty-one species. Only a single species of may-fly and no dragonflies have so far been recorded. Among the fifty-four species of Lepidoptera only four are butterflies. Of particular note is the Noctuid moth *Rhyacia occulta* L., the larvæ of which are often pests of the grassland. In two peat bogs at the head of the Ameralik Fjord an entire layer of pupæ of this insect is recorded, and it bears witness to an outbreak of *R. occulta* in bygone times. Coleoptera are poorly represented and number only forty-four species while some of them, notably Cerambycidæ, are introduced forms. Among the Hymenoptera the Parasitica are relatively very numerous, but little idea can be framed as to their hosts. Records of sixty-five species of the Ichneumonidæ alone are given, whereas the only Aculeata recorded are two species of bumble bees. Of the Diptera some two hundred and seventy-five species are listed, Nematocera being the best represented. Mr. Henriksen's memoir concludes with a bibliography of about eighty references, the majority being to writings in the English language.

Hormones and the Garden

THE discovery of growth-promoting compounds in plants brought new opportunities of horticultural propagation. Marked stimulation in the rooting of cuttings of many species can be brought about, but a curious crop of failures has still to be explained. M. A. H. Tincker, with the assistance of C. H. Unwin, has studied the action of a number of such substances upon a wide range of plants which can be propagated by cuttings. Their most recent results (*J. Roy. Hort. Soc.*, 64, Pt. 12; December 1939) indicate that sixty-one species of those which were tried propagate more readily with treatment, whilst twenty-nine species still defy the propagator. The growth-promoting substances can be mixed with talc and applied satisfactorily in powder form—a great convenience.

Vitamin B_1 (aneurin) alone did not appear to stimulate rooting, but it did increase the percentage of rooted cuttings in a third of the total experiments. The most valuable substances for propagation were found to be (1) indolylbutyric acid, (2) tetrahydronaphthylideneacetic acid, and (3) a mixture of (2) with 3 : 4-dihydro-1-naphthylacetic acid. Some species responded to (1), and others to (2), with equal effect, and the behaviour of (3) approximated closely to (2). The paper gives numerous results of the individual calibre which is urgently needed in this new practice of scientific horticulture.

Sex-chromosomes in Cimex

C. D. DARLINGTON (*J. Gen.*, 39, 101–136 ; 1939) has examined the behaviour of the sex-chromosomes during meiosis in Cimex. In the male there are 13 pairs of autosomes, a *Y*-chromosome, together with a variable number of *X*-chromosomes ranging from 2 to 12 according to the species and the culture. At first metaphase, the *X*-chromosomes do not pair but divide as univalents. At the second division, the autosomes form a peripheral ring and the sex-chromosomes congregate in the middle of the equatorial plate. At second anaphase, the *Y*-chromosome passes to one pole and usually all the *X*'s pass to the other. This is believed to be brought about by repulsion resulting from a close approximation in the centre of the equatorial plate. Evidence suggested that the centromeres of the autosomes have polarized centromeres at second metaphase, while the *X*-chromosomes have not. The evolution of the sex-chromosome mechanism in Heteroptera is analysed, and it is shown how the peculiar behaviour of the *X*-chromosomes results from differential precocity.

Effect of X-rays on *Drosophila subobscura*

A. L. M. CHRISTIE (*J. Gen.*, 39, 47–60 ; 1939) has compared the effects of X-ray radiation on *D. subobscura* with those on *D. melanogaster*. The frequency of lethal mutations induced by X-rays is about equal in the two species, but many more visible mutants occur in *D. subobscura* at a given X-ray dose. It is noteworthy that *D. subobscura* lies between *D. melanogaster* and *D. funebris* in regard to the type of mutation produced. Twenty-eight mutants are described, and a rough map of the *X*-chromosome, approximately 120 units long, is given.

Mycological Taxonomy

THE *Transactions of the British Mycological Society* of October 1939 (23, Pt. 3) contains two papers which offer detailed contributions to the exact recognition of fungal species. J. A. Nannfeldt, of the Institutionen för Systematisk Botanik, Uppsala, describes a second batch of fifty type specimens of British inoperculate Discomycetes. This is part of a critical evaluation of species in this group, and deals with an alphabetical arrangement from Cenangium to Velutaria. The correct name of each species in the light of modern knowledge is indicated, and an adequate list of synonyms appears for each. Miss E. M. Wakefield writes the second contribution, on "Nomina generica conservanda". She sets forth the deliberations of the Society's Nomenclature Committee with regard to such generic names as now appear to have little use, after recent findings have excised well-defined groups. Peziza, for example, a generic name established by Fries in 1822 to include a large group, cannot now be used to express more than a few species. The Committee has made definite recommendations for the retention of thirteen names in the lists published as a supplement to the International Rules, 1935. A new species of fungus, *Phleospora Dodonææ*, is also described by R. M. Nattrass in the same volume. It was found as a parasite upon a hedge of *Dodonæa viscosa* in Cyprus.

Life-Histories of Coprophilous Fungi

DETAILS of the life-histories of coprophilous Pyrenomycetes have been somewhat lacking in the past. Literature dealing with the Sordariaceæ and Chætomiaceæ, which are principally concerned, consists largely of descriptions of perithecia, asci and spores, or systems of classification. W. M. Page has grown, upon artificial media, sixteen species belonging to the genera Sordaria, Podospora, Philocopra, Sporormia and Chætomium, in order to obtain more definite information as to their life-histories (*Trans. Brit. Mycol. Soc.*, 23, Pt. 3, October 1939). The perithecium originates from a coiled hypha in all but two of the sixteen species. The exceptions, two species of Sporormia, are notable in that the perithecium initial divides in three dimensions, probably an indication of evolutionary superiority. Microconidia were observed in *Podospora anserina* and *P. minuta*; many other details of spores and spore discharge appear in the paper.

Research in Agricultural Meteorology in India

IN addition to the brief summary of the more recent activities of the Agricultural Meteorology Section of the India Meteorological Department that is included in the Department's general report for 1938–39, a more detailed account has recently appeared of the Section's work in 1937–38 in its annual report for the latter period. This report includes a description of an improved portable sensitive galvanometer with thermocouple junctions for measuring plant temperatures, made by the Laboratory Apparatus Works, Poona. One of the thermocouples is kept immersed in water of known temperature inside a thermos flask, and the other is inserted into the stem of the plant. When used in the field the instrument is carried on a metal tripod and is levelled with the aid of a spirit-level. A number of soil evaporimeters were in use in which a 5-in. diameter cylinder of soil is kept with its bottom end in contact with the water in a reservoir at a depth of 6 in., or 1 ft., etc., down to 3 ft., in order to study the evaporation from soil surfaces with subsoil water at these depths. Other instruments included an alarum which could be set to sound when air temperature had fallen below a certain level, so that a farmer who installs the device can take precautionary measures against frost damage on hearing the alarum. It has been found that there is an increasing demand for these, vine and sugar growers being among those who have found it useful. Investigations into the disposal of solar radiation and rainfall at the surface of the ground were continued at the Central Agricultural Meteorological Observatory, and also the exchange of water vapour between soils, plant materials, seeds, etc., on one hand and the atmosphere on the other. It was found that all the last-named surfaces yielded moisture to the atmosphere during the hottest hours of the day and received back moisture at night. On the statistical side, sampling studies on the growth and yield of various crops at Poona and other places were continued.

SALT ABSORPTION OF PLANTS

BY PROF. H. LUNDEGÅRDH,

INSTITUTE OF PLANT PHYSIOLOGY, ULTUNA, UPPSALA

IN a communication to NATURE I outlined an electrochemical theory of salt absorption by plant roots[1]. Later, Hoagland and Steward criticized not only the theory itself but also the data on which it was founded[2]. From the article by Hoagland and Steward the general reader might get the impression that the experimental basis of my theory is doubtful. I therefore venture to give a short recapitulation of the work of the Institute of Plant Physiology in Ultuna, Uppsala.

Since 1927 our work has been chiefly devoted to the problems of salt absorption in higher plants. In 1927–32 extensive quantitative investigations[3] on salt absorption showed a wide application of the rules of colloidal chemistry to the process of uptake and transport of cations, and an elaborate study of the antagonistic effects was published in the year 1934 by H. Burström[4]. Also the specific velocity of the anions was demonstrated in earlier papers[5]. The principle of the individual absorption of cations and anions postulates an ion exchange at the surface of the absorbing cell or organ, a well-known fact stated in modern text-books of plant physiology[6]. The existence of such an ion exchange suggested the study of the total ion balance in the boundary between root and medium, including the HCO_3 ions, coming from the expired carbon dioxide. After a preliminary study on this balance[7], it seemed necessary to determine quantitatively the respiration during the ion absorption. These studies soon showed a marked relation between the intensity of root respiration and the amount of absorbed salts[8]. In view of our previous experience in the individual absorption of ions of opposite charge, we tried to correlate the respiration with the uptake of cations and anions. In these experiments one anion, for example, NO_3 or Cl, was combined with a number of cations of different absorption velocity, and also the concentration of the salts was varied. The respiration showed a marked relation to the amount of absorbed anions, and thus the conception 'anion respiration' arose (1933). Apart from the anion respiration the root tissue, as well as all living organs, shows also a fundamental respiration. The total respiration is the sum of the fundamental and the anion respiration[9].

Parallel to the work of Lundegårdh and Burström, Steward and Hoagland and collaborators showed that 'aerobic metabolism' is essential to salt absorption. But they were not able to find either quantitative relations or an individual absorption mechanism of anions. The cause of these negative results of Hoagland and Steward is twofold. They limited themselves to a very restricted combination of cations and anions; then their choice of material and experimental technique was inappropriate. In studying quantitatively a physiological process it is very important to choose an organ which is exclusively designed to effect this process. The root system of grass plants is an intensive working absorption machine, which pumps salts into the lower parts (that is, the region of root hairs) and transports them into the upper parts. The bleeding sap which issues from the top of a cut root system contains salts in a much higher concentration than the solution from which these salts are pumped[10]. Hoagland and Steward used either slices of very slowly absorbing storage tissue, or ignored roots which were submerged in the solution. In the former case the ion absorption is too small to render possible an accurate determination of the coupled respiration process, because this will be covered by the variations of a considerable fundamental respiration. In the latter case the root pieces will pump in salts from the solution at the lower end and pump them out again at the top, and the amount stored up in the tissue will for this reason give an incorrect picture of the absorption intensity. Recently, van Eijk[11], at the University of Amsterdam, repeated the experiments of Lundegårdh and Burström on roots of a plant of a type quite different from wheat, namely, *Aster tripolium*. Van Eijk confirmed the "Lundegårdh principle of salt respiration". He presented, furthermore, a detailed criticism of Steward's experiments and draws the following conclusion (in translation): "Steward's criticism of Lundegårdh's investigations cannot be sustained, because it is built upon experiments, the method of which is insufficient to demonstrate the anion respiration or on experiments with subjects which *a priori* must cause negative results"[12].

I have repeatedly tried to explain that in the case of the roots of a number of plants the absorption mechanism will function fairly well, if respiration energy is supplied only when anions are absorbed[13]. The protoplasmic colloids and also the free surface of the root cells have negative electrical charge and thus attract cations. This absorption potential will lead to an accumulation of cations in the protoplasm. But this accumulation stops when the absorption surfaces are saturated. If now anions are simultaneously absorbed by means of an energy-expending respiration process, these anions will, when they come into the cells, remove cations from the absorption surfaces and cause an accumulation of neutral salts. This theory implies also that anions, for example, of organic acids, are produced within the cell itself. In this case the cation absorption will proceed, even if no anions are absorbed from the outside. But the metabolic activity through which organic acids are produced should not be confused with the anion respiration process which enables inorganic anions to enter the cell. This is a very important distinction. Burström has shown that it is possible to distinguish experimentally between the process by which NO_3 ions are absorbed in the root and the chemical mechanism of NO_3 reduction[14]. I showed recently that manganese is a catalyst for fundamental respiration processes, but fails to influence the anion respiration and anion absorption[15]. Burström discovered that manganese is essential for the reduction of NO_3, but has no influence on the NO_3

absorption process[16]. Earlier investigations by Lundegårdh and Burström[17] demonstrated a remarkable difference in the sensitivity of the fundamental respiration and of the anion respiration to cyanide and metallic poisons. Hoagland and Steward seem to have overlooked these results, which prove the possibility of dividing up the 'aerobic metabolism' into at least two distinct groups of processes :

(1) the fundamental respiration complex, which is characterized by its insensitivity to cyanide and the catalytic action of manganese, and

(2) the anion respiration, which is very sensitive to cyanide, but independent of manganese.

Very important is Burström's result that nitrate reduction persisted in crushed root material, whereas the absorption of NO_3 from the solution takes place only if the living organization is intact[18]. This observation conforms with my theory of ion absorption, which postulates the existence of an electrically charged absorption surface and an internal respiration mechanism, which transports the ions to the interior of the cell or organ[19]. The theory assumes a polarity (that is, a one-sided movement of substances) which, of course, will be destroyed if the living substance is crushed.

The complex of fundamental respiration is to be considered as the sum of a number of exothermic chemical processes, which build up cell substance, for example, protein synthesis and growth material of any kind. Some ions, for example NO_3, no doubt participate in both respiration systems : the anion respiration during the uptake, and the fundamental respiration during the reduction and proteinization process. If the cation NH_4 produces an acceleration of the total respiration of the root, as Hoagland and Stewart claim[20], this might be due to an increase in the fundamental respiration complex, because protein synthesis involves a partial breakdown of carbohydrates. Cations which do not interfere with organic chemical processes within the cell, for example, alkali metals and alkaline earth metals, are to a limited extent absorbed from bicarbonates without any increase in the respiration[21].

The coefficient $k = \frac{Ra \text{ (anion respiration)}}{A \text{ (anion absorption)}}$ is fairly constant, if A is varied by means of variations in the concentration of one single salt. If the effect of salts with the same anion but different cations is studied, k changes somewhat with the type of cation. As a rule k increases with the absorption power of the cation[22]. The circumstance that the quotient $\frac{A \text{ (= absorbed anions)}}{M \text{(= absorbed cations)}}$ also increases with k is an expression of the fact that k is a function of the work which the living organ has to perform in the absorption process[23]. Work can also be expressed in terms of electro-chemistry, and this was the reason why I started a series of observations of the boundary potential between the root and the solution. The results of these investigations have been fully described in two papers[24], and the studies are being continued. Hoagland and Steward also criticize these results.

Hoagland and Steward claim that the potential measurements are performed on "ill-defined" surfaces. I do not know whether they consider the boundary between root epidermis and nutrient solution to be nebulous and unfit for producing an electrical double layer. Speaking in well-known terms of physical chemistry, the existence of electrical potential differences, not only between the root surface and the solution, but also between cell sap and protoplasm, between nucleus and protoplasm, etc., is self-evident. Bio-electrical currents arise everywhere as a consequence of such boundary potentials, if a circuit is closed, and countless measurements of such bio-currents have been made. In an organ the cells are coupled wall by wall and the opposite charges therefore to a large extent neutralize one another. For this reason observed potentials arise, in the majority of the cases, in the boundary between the cell or organ and the electrode. In my experiments the problem was settled by the fact that a sudden change in the electrode solution caused an instantaneous change in the boundary potential, the height of which corresponded with what was electro-chemically to be expected. The boundary between the tissue of the root tip and the solution is consequently well defined, and its behaviour corresponds with well-known laws of physical chemistry.

From a thermo-dynamical point of view, the existence of a boundary potential at the surface of the root must act as a regulator upon the ion absorption (exchange) from the surrounding solution. A number of earlier investigations on animal tissue and also on roots[25] show a distinct relation between respiration and potential. Unpublished results from this laboratory confirm the existence of such a relation and the fact, postulated in my letter to NATURE, that a fraction of the root respiration (that is, anion respiration) causes an increase of the positive charge (a lowering of the negative charge) of the root surface, thus facilitating the absorption of anions.

Hoagland and Stewart claim that my theory of ion absorption means an "over-simplification of a very complicated problem". The experimental work of this Institute shows, on the contrary, that the absorption of inorganic ions is far more complicated than earlier investigators, among them Hoagland and Steward, believed.

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[18] Burström, H., *loc. cit.* (1939 *a*).

[19] Lundegårdh, *loc. cit.* (1935).

[20] *loc. cit.* (1939).

[21] Lundegårdh, *loc. cit.* (1937).

[22] *loc. cit.* (1937).

[23] Lundegårdh and Burström, *loc. cit.*, p. 250 (1933).

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[25] Rosene, H. F., and Lund, E. J., *Plant Physiol.*, **10**, 27 (1935).

BY PROF. D. R. HOAGLAND, UNIVERSITY OF CALIFORNIA

AND

DR. F. C. STEWARD, UNIVERSITY OF LONDON

Our earlier article directed the attention of the general reader to two independent series of investigations which have been in progress in different laboratories for several years. The combined investigations are extensive and deal with a variety of plant materials and environmental conditions. These apparently divergent investigations yield a consistent general picture of the process of salt uptake in plants, and we are not persuaded by Prof. Lundegårdh's arguments that this picture can be dismissed by the general reader. Our view is that salt accumulation involves vital processes in a more complex and intimate manner than would be suggested by Prof. Lundegårdh's discussion with its reference to principles expressed "in modern text-books of plant physiology" and "well-known terms of physical chemistry".

Prof. Lundegårdh's rejoinder mainly recapitulates his own earlier work. It will be recalled that we had raised the following general points.

(1) Any view of the metabolic processes concerned with salt uptake which has as its dominant feature carbon dioxide production, and especially a limited phase of carbon dioxide production conditioned only by anion uptake, is too restricted. Other vital processes are also concerned, perhaps more fundamentally. Pre-eminent are metabolic properties which are characteristic of cells still able to grow; but which are still difficult of quantitative expression.

(2) There is not, in our view, the sharp distinction in the relation of metabolism to the uptake of cations and of anions, described by Prof. Lundegårdh.

(3) The effects of salts on respiration—undoubted alike for roots and a variety of storage organs—are not related specifically to anion absorption; cations also exert an influence, which is the predominant one for some tissues, and the effects of differential absorption of cation and anion introduce additional factors.

(4) The storage tissue experiments deal with cells uniform in origin, subject to rigid control, in which the capacity for further growth is known. Root systems can never provide such uniform material; but in the experiments of Hoagland and Broyer special methods yielded root material which was replicated with accuracy well within the requirements of the investigation described. By the special control of nutrition the experimental barley plants yielded tissues with a great capacity for salt uptake, apparently much greater than that possessed by the wheat plants used by Lundegårdh.

(5) Neither respiration nor salt uptake occurs uniformly throughout the root system. In calculating an arithmetical relation between respiration and anion absorption Lundegårdh takes no cognizance of this fact, nor of the complications caused by interaction of root and shoot.

(6) Lundegårdh's references to bio-electric phenomena do not elucidate the problem. The surfaces involved were not precisely defined and in any event the origin of such bio-electrical potentials is still controversial.

We may now note those parts of Prof. Lundegårdh's second article which refer to these points.

Lundegårdh states that we did not find the quantitative relations demanded by the concept of anion respiration because:

(a) The choice of treatments was too restricted.

(b) The process of salt uptake must be studied in an "organ exclusively designed to effect this process" and therefore experiments on cells of storage roots and stems are not admissible.

(c) The work of Hoagland and associates on excised roots is subject to the assumed complication that salts absorbed may exude from the single cut surface back into the external solution, so that the amount in the tissue is not a correct measure of that which is absorbed.

We are unable to accept these arguments. To restrict experimental attack on problems of salt uptake to any particular organ, for example, roots of grasses, is an unjustifiable and arbitrary conception. Salt uptake is one of the most general properties of living cells during their growth, and general conclusions must embrace the results of experiments on a wide range of cells and tissues. Our views were based on experiments on roots of barley and potato, a variety of storage roots, stems and modified leaves, growing leaves of dicotyledons and monocotyledons, as well as submerged aquatics and green algæ. While the most intensive investigations have demanded a restricted choice of materials. the general picture we have presented embraces work with all.

Lundegårdh implies that in storage tissues the anion absorption is too small to reveal the anion respiration effect. However, we clearly stated that in experiments that cover a wide range of salts and salt concentrations the *entire metabolism* of the tissue (not merely respiration) responded to the salt treatment. The ion absorption *was* large enough to produce marked effects, which are different in *kind* from those described by Lundegårdh.

Lundegårdh cites no proof that submerged, excised roots continue to exude salt. In any event, Hoagland and Broyer have made numerous studies on exudates of barley roots and find that the salt present in such exudates during the brief duration of the experiments is equivalent only to a very small fraction of the total salt absorbed by an active ("low-salt, high-sugar") root system. Comparisons have also been made between the salt removed from solution by intact plants and by submerged, excised, root systems. With plants having a high capacity for salt absorption, and for the short periods of the experiments, the excised roots and corresponding entire plants absorbed salt in quantities of similar magnitude. The ion uptake, for example, of potassium and easily absorbed anions was very large, and so far as we can find a basis for comparison, was more rapid than that reported by Lundegårdh or, indeed, by any other investigators of salt absorption in plants. As in the case of the storage tissues, we are certain that the roots absorbed salt in amounts and at rates such as to produce striking metabolic effects, although certain aspects of metabolism may be more prominent in one tissue than in the other.

We have not found anything in Lundegårdh's rejoinder to warrant discarding our view that the implications for the problem of salt uptake of bioelectric measurements are still obscure—we only wish it were otherwise. Amongst those who favour this line of work there cannot be said to be agreement concerning the nature or origin of the phenomena they investigate. Lundegårdh's re-statement still does not convey to us a clear picture of the boundaries which he regards as the seat of the phenomena he measures ; that is, whether this membrane is one of cells, for example, piliferous layer (epidermis of Lundegårdh), root cortex, or endodermis separating an external and internal intercellular fluid, or is a protoplasmic boundary membrane, across which the phenomena of ion accumulation in cells actually occur. Such phrases as "root tip" relative to electrode measurements require much more precise definition before they convey any anatomical meaning.

To return to the constant '*k*' of anion respiration. It is said to be "fairly constant" for an anion present only as a given salt (although in the experiments with barley roots this function would not be constant even with this restriction). With different cations the value of '*k*' is now said to "change somewhat", and it varies also with the ratio of absorbed anions to cations. So versatile a "constant" seems to us to lack utility.

Our purpose in this and our former communication is to suggest to the general reader the complexity of the problem of salt absorption by living cells, and also that the theory of Prof. Lundegårdh has not yet been established and generally accepted by plant physiologists. With regard to the quoted work of van Eijk on the salt marsh composite *Aster tripolium*, we note that it is rather the principle of a salt effect on respiration which van Eijk confirms (with which we are not in disagreement) and not the reality of the special anion effect, which even by van Eijk seems to be regarded as an open question. Van Eijk's values for the quantity "K" do not show that this has a constant value specific for each anion.

Finality cannot be obtained by further exchange of views in the columns of NATURE. Although we hope that the present discussion may serve a useful purpose, its continuance in this journal could not be justified.

STATISTICS AND ENGINEERING PRACTICE

DR. B. P. DUDDING and W. J. Jennett, of the G.E.C. Research Laboratories at Wembley, have contributed a paper on "Statistics" to the Institution of Electrical Engineers which was published on January 5 and should prove useful in engineering applications. Although there was no spoken discussion, the authors have made some minor changes so that it can be read as a contribution to a general written discussion which will be concluded not later than February 5.

The theory of statistics as a distinct branch of science did not begin to flourish until the last quarter of the nineteenth century ; in England, the work of Galton and Karl Pearson laid the foundations of the applications of the theory to many fields of science. Research workers in biological sciences and in agricultural industry were the first to turn these more recent advances to practical use. Great interest was stimulated by a series of lectures given by Dr. Shewhart at University College, London, in 1932. Later, the British Standards Institution formed a committee charged with the following terms of reference :

(1) To report on the application and use of statistical methods in standardization and specification of quality ; (2) to draw up a short report which would serve to awaken interest in the application of statistical methods on the part of manufacturers and others concerned with problems of standardization and specification ; (3) to consider what encouragement is necessary for the development of research on improved statistical methods and their application to industry ; and (4) to consider what steps should be taken to provide for co-operation with bodies in the United States of America and elsewhere instituted for similar objects.

Out of this activity also grew the formation of the Industrial and Agricultural Research Section of the Royal Statistical Society. The meetings of this Section have provided opportunities for technicians employed in industry to meet statisticians and for statisticians to meet and discuss with technical people the difficulties which arise in trying to apply statistical methods to the examination of industrial data. Many institutions have been interested in this development. At the present time, there are few industrial products which are not expected to conform with some standard of quality. Measures are taken to ensure that finished products will conform with quality standards demanded by consumers.

The main object of Messrs. Dudding and Jennett was to emphasize the essential statistical nature of many technical problems and the part that chance plays in many technical decisions, and to demonstrate the need for a technique which will give assistance in making deductions from test data.

The following technical improvements and economies accrue to those industrialists who cultivate the statistical outlook and apply statistical methods to the scrutiny of their data. The errors of judgment arising from ambiguities due to the effect of chance, which lead to incorrect action, are reduced. Development work involving reasonably large-scale production can be planned most economically and the results rightly appraised. The efficiencies of the specifications used can be improved, and simple and efficient systematic methods of presenting data requiring daily scrutiny can be readily devised.

The authors explain fully the academic method of considering the frequency distribution of observations by the Gaussian curve, and the use of mean and standard deviations is explained. The importance of the methods given for carrying out specifications which involve sampling is clearly stated.

Numerical examples are included which will help those beginning the study of variance. An example has been given where an experienced engineer lacking statistical knowledge, and the statistician lacking practical knowledge, would probably have come to the same erroneous conclusion. Correct diagnosis of the difficulty in the factory was only possible by a combination of the attributes of the two.

SEVENTY YEARS AGO

NATURE, vol. 1, January 20, 1870

Kant's Views on Space

PROF. T. H. HUXLEY concludes a letter on this subject with . . . "there can be no doubt that that thorough and acute student of Kant, Dr. Ingleby, was perfectly right when he said that Kant would have repudiated the affirmation that 'space is a form of thought'. For in these sentences [quoted from Kant's writings], and in many others which might be cited, Kant expressly lays down the doctrine that thought is the work of understanding, intuition of the sense ; and that space, like time, is an intuition. The only 'forms of thought', in Kant's sense, are the categories."

Projected Channel Railways

THE second of a series of three articles on this topic was published. The first article discussed the cultural advantages for Great Britain of closer connexion with the continent of Europe, and proceeded to demolish a fantastic scheme for a railway bridge across the English Channel. The second article dealt with a proposed Channel Tunnel and included a map of the route from the engineers' report issued by the promoters. "We are of opinion that it is not an unreasonable proposition, to drive a tunnel under the Channel, but that in some measure it must be a venture. If we are to undertake such a venture to gain a magnificent prize, of immense value to the English and French nations, we must be prepared to meet all ordinary eventualities. . . . The first step towards accomplishing the object would be to obtain a geological section across the Channel . . . from actual test of the materials which compose the bed of the Channel."

Meteorological Blockade

SIR WILLIAM THOMSON, F.R.S. [afterwards Lord Kelvin] discusses Dr. Balfour Stewart's proposal for a cordon of meteorological stations around a district to keep an exact account of the quantity of water vapour entering and leaving the space over the district in question. "This appears to me a most valuable proposal, which, if well carried out, must have a very important influence, tending to raise meteorology from its present empirical condition to the rank of a science . . . the same system of account-keeping ought to be applied to electricity . . . among the many unknown quantities involved, the two departments of the blockade combined will give means for eliminating some and estimating others."

WE notice that an individual was examined on Tuesday at Worship Street on the charge of sweating sovereigns. The details of the case, which are of considerable importance to the public, will be watched with interest. It appears that the coins are dissolved by acid, aided by a battery, and that the loss in some cases equals about two shillings in the sovereign.

IT was announced by Mr. Lockyer at the meeting of the Royal Astronomical Society on Friday last, that the great refractor of 25 inches aperture, constructed by the Messrs. Cooke, of York, is so near completion that it will be erected in the observatory prepared for it at Gateshead early next month.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING AND PHYSICS at the Technical College, Coventry—The Director of Education, Council House, Coventry (January 26).

HEADMASTER for the Pentre Junior Technical School—The Director of Education, Council Offices, Pentre, Rhondda (January 27).

TEMPORARY INSTRUCTOR LIEUTENANTS in the Royal Navy—The Director, Education Department, Admiralty, Whitehall, S.W.1 (January 31).

GRADUATE ASSISTANT to teach ENGINEERING Subjects, PHYSICS and MATHEMATICS—The Principal, Hendon Technical Institute, The Burroughs, N.W.4 (January 31).

ENGINEERING WORKSHOPS INSTRUCTOR to take Engineering Drawing and Allied Subjects (Elementary Mathematics and Mechanics)—The Principal, Hendon Technical Institute, The Burroughs, N.W.4 (January 31).

LECTURER (Grade II) IN DENTAL PROSTHESIS—The Secretary and Registrar, University, Bristol (February 10).

DIRECTOR OF RESEARCH of the Linen Industry Research Association—The Secretary, The Research Institute, Lambeg, Co. Antrim (March 1).

JUNIOR ASSISTANT CHEMISTS—The Secretary, Linen Industry Research Institute, Lambeg, Co. Antrim.

ENGINEER for the Public Works Department of the Government of Hong Kong—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9006).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Bureau of Animal Breeding and Genetics. Animal Breeding in the Light of Genetics. (Seventh International Genetical Congress, Section D.) Pp. 78. (Edinburgh and London : Oliver and Boyd.) 3*s*. [2812

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Year 1938. Pp. iv+84+4 plates. (London : H.M. Stationery Office.) 1*s*. 6*d*. net. [2912

International Journal of Agrarian Affairs. Vol. 1, No. 1 : The Problem of Surplus Agricultural Population. Pp. 96. (London : Oxford University Press.) 3*s*. 6*d*. net. [21

Thirtieth Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1939 : being the 83rd Report relating to the Customs and the 82nd Report relating to the Excise. (Cmd. 6098.) Pp. 205. (London : H.M. Stationery Office.) 3*s*. net. [21

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Congregation during the Academical Year 1938–39. Pp. 22. (Durham : The University.) [31

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 690 : The Acidic Properties of Peat and Muck. By Irvin C. Feustel. Pp. 42. (Washington, D.C. : Government Printing Office.) 10 cents. [2812

Bulletin of the American Museum of Natural History. Vol. 76, Art. 8 : Body-Forms of the Black Marlin (*Makaira nigricans marlina*) and Striped Marlin (*Makaira mitsukurii*) of New Zealand and Australia. By William K. Gregory and G. Miles Conrad. Pp. 443–456+plates 3–6. (New York : American Museum of Natural History.) [2812

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SCIENCE AND EDUCATIONAL POLICY

THE statement of the Prime Minister that the aims of Great Britain during the present struggle must be sharply differentiated into war aims and peace aims amounted to much more than a reply to the demands for a clarification of what is to be our attitude when the War comes to an end. It is essential, however, that the wider peace aims should be constantly reiterated in order that they may remain fixed before our eyes. It would be more than regrettable if the ideals of freedom, liberty and equality that have led the Allies to take up arms were lost sight of even temporarily in our efforts to defeat the enemy. Mr. J. B. Priestley, in speaking of the drama, said recently that a momentary blurring of the objects for which we are fighting would be enough to invalidate our reasons for having gone to war.

A real and immediate problem which deserves consideration is whether a long-term national policy of scientific education ought not to be introduced into the schools of Great Britain. It is becoming more and more apparent that the provision of scientific education is far from being scientifically planned, a matter which could be adjusted by closer co-operation between scientists and educationists. Here the different forms of educational institutions would have to be considered not separately but as components of a system which aims at the development of beings whose lives are continuous processes. In this respect the insistent demand raised in the report of King George's Jubilee Trust* for continuation classes for all up to the age of eighteen should receive adequate consideration. The Industrial Revolution, the growth of the physical sciences, the mechanization of ways of living with its consequences in transport, communication and manufacture have all combined to produce an environment in which educational equipment in many cases leaves the ordinary citizen thwarted and helpless. The ideal of science is the pursuit of objective truth ; if material progress is to continue, it is essential to keep this ideal clearly in view in the prosecution of measures whereby scientific truths might be made to contribute to human welfare.

Reflection on the standard of living of masses of the population makes one painfully aware that the applications of well-established scientific truths are not being carried out in an efficient and objective fashion. There is no need to emphasize the fact that science must look for a policy which will in no respect imitate the nationalistic efforts of countries where scientific truths are distorted to conform to ideological needs. Various factors indicate that the population of Great Britain is likely to decrease during the next few years. If, as compensation, the quality of the people is to be improved, scientific workers, and especially those in the biological field, should decide the paths upon which the course of science development is to be guided.

Co-operation between scientific workers and educationists led to marked improvement in living standards of the nation while we were at peace. In these times of stress and anxiety, the value of the wider extension of scientific methods of thought and practice is apparent. The national effort will only reach its maximum when due regard is paid to the health of the nation as a whole. In this connexion, it is doubtful whether scientific workers are being allowed to play a sufficiently active part in the various schemes of food production and control. Much could be done, especially in the reception areas, by the introduction of classes for teachers and youth leaders, where the specific problems bound up with evacuation could be discussed. The Workers' Educational Association, the Townswomen's Guilds and other bodies have already sponsored classes of this type. These could be usefully extended. The rural community councils and women's institutes provide means whereby scientific practice could be more quickly transferred to non-urban communities.

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* "The Needs of Youth". By A. E. Morgan. (London : Oxford University Press, 1939.)

One aspect of this policy would be the need for greater and more effective co-operation between scientists and educationists in deciding upon the content of the general school curriculum, and in particular the science part itself. The Science Masters' Association has approached the problem in the right manner by taking steps to revise examination syllabuses in liaison with university staffs; this has resulted in the publication of reports on various subjects, including the recent one on the teaching of general science. But their scope of action is necessarily limited, and the origins of the present conflict indicate the necessity for a re-orientation of the school science content if the ideals expressed in the Spens Report are to be given effect. The Consultative Committee responsible for this report has in no wise exaggerated the case when it states that even the possibilities of science teaching have not yet been fully apprehended.

One of the more urgent problems that calls for investigation is the need for a clearer definition of the concept of social biology as an educational medium. Another avenue that could be explored with profit by scientists and educationists is the present rating of science in many school syllabuses. Apart from its use in technical and vocational training, science as an educational subject often receives poor recognition. In the Common Entrance Examination to Public Schools, for example, Latin still remains as the symbol of what is to be desired in the shape of compulsory attainment, while science is relegated to a minor, optional position. This specific instance is but a general symptom of a condition which is more widespread than is obvious on superficial examination. Such an assessment often fails to accord both science and industry their true social worth, while much useful talent is frequently diverted elsewhere. Further, in many schools science is considered to play little or no part in the process of character training; such restrictions lead to numerous psychological problems, centred upon the true worth of science, which have no real foundation. If some of these difficulties are to be adjusted, considerable effort will have to be exerted by scientific workers with an interest and enthusiasm that is based upon inflexible moral purpose and a real concern for human progress.

The difficulties encountered in the development of the Colonial Empire merit special attention. Until very recently the significance of the tropical and sub-tropical Dependencies has been viewed as through a glass, darkly. It is a tribute to our administrators that, despite this lack of interest in Great Britain, in at least some parts of the Empire it is more than probable that education is being approached in a spirit that approximates more nearly to being truly scientific than is the case nearer home. In some places excellent results are being obtained, and the part played by educationists in the establishment of stability in these rapidly evolving Colonies demands the widest recognition. The recent extension of the college for native African students at Makerere in Uganda is a new milestone in colonial development. In the Colonies, greater interest shown by scientific workers would produce even more striking results.

It has yet to be decided whether positions of importance in the Colonies should be allocated to men and women who have specialized only in one or two branches of science. Evidence comes to hand constantly to show that, whereas specialists are essential for university teaching and research posts, for general educational purposes the Colonies need people with a wider scientific training, preferably with a biological bias; it may be added that there is a body of opinion in Great Britain which maintains that this is also applicable to home conditions. For the Colonies, undoubtedly, greater attention should be paid to the recruitment of those whose task it will be both to undertake teaching duties themselves and to train and inspect native teachers in the Colonial Empire.

The planning of programmes for the present year is more than hazardous at this time, but, because of the rich opportunities which are presented, it is to be desired that responsible authorities will make at least tentative preparations for the holding of 'refresher' courses and vacation schools wherever this is possible. In general, 'refresher' courses in science have either been concerned with imparting pure academic or technical knowledge, or have served their purpose in spreading scientific knowledge and principles to a wider audience. The latter would probably be the more fruitful course to be adopted while we are at war. Opportunities might be provided during the approaching summer for teachers, club leaders and other youth workers to be able to make refreshing contacts with members of their own professions, and to obtain valuable help and guidance from leading scientific workers and educationists. For various reasons, it seems unlikely that the Board of Education will be able to proceed with its admirable courses in science during the summer, so that the opportunities provided by other organizations would be of inestimable value.

MEMORIES OF A PALÆONTOLOGIST

Some Memories of a Palæontologist
By William Berryman Scott. Pp. vi+336. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1939.) 17*s*. 6*d*. net.

DURING the past sixty years, American palæontologists have taken a very large share in adding to our knowledge of fossil mammals. They have not only made remarkable discoveries on their own continent, but have also worked in close association with their colleagues in other countries.

Among them during the whole of this long period, Prof. William B. Scott, of Princeton University, has been especially active, and few have ranged over a wider field. Since 1877, when he made his first collecting expedition to the West with his classmate, Henry Fairfield Osborn, until the present day, when he has joined Prof. Glen L. Jepsen in preparing a large memoir on the Oligocene mammals from South Dakota, he has travelled and engaged in research with tireless energy. His experiences therefore have been many and varied, and while occupied with his own technical problems he has seen much of the world in general. He has now recorded some of his memories in an attractive volume which will be welcomed by all who are interested in the ways of life of scientific men.

Prof. Scott, through his mother, is a great-great-great-grandson of Benjamin Franklin, and he began life at Princeton in unusually intellectual surroundings. From the beginning his inclinations were towards natural science, and when he was a schoolboy his interest in geology was first roused by his grandfather who made some casual remarks to him about the nature of coal. At Princeton he studied under Prof. Arnold Guyot, whom he eventually succeeded in the professorship of geology. In London he attended Prof. Huxley's course in comparative anatomy; at Cambridge he studied embryology with Francis M. Balfour; and at Heidelberg he spent much time in research under the direction of Carl Gegenbaur. He was thus well equipped for both geological and biological work, and he gives many interesting reminiscences of his teachers and distinguished fellow students. His visits to Europe also brought him into contact with other leaders in geological and biological science of whom he records impressions. His experiences of England and Germany seem to have been particularly happy.

Prof. Scott has much to say of life in Princeton, where he witnessed the growth of the old College into the University. He describes his expeditions to the West to collect fossils, beginning in the days when the Indians were still troublesome; and he makes many references to the rivalry of Cope and Marsh, who were his predecessors in the field. There are also observations on South Africa, which he visited with the British Association in 1905; on Panama, which he visited in 1911; and on Spain, where he attended the International Geological Congress in 1926.

Prof. Scott's most important work outside North America was his organization of the Princeton University Expedition to Patagonia under Hatcher and Peterson during 1896–99. Between 1901 and 1931 he edited the series of handsome volumes which record the results, and he himself contributed most of the descriptions of the fossil mammals. In 1901 he visited the Argentine so that he might study and photograph the fragments of similar fossil mammals in La Plata which had already been described by Ameghino and others. Reminiscences of this journey occupy an interesting chapter.

During the past few years Prof. Scott has not only continued the researches on Oligocene mammals already mentioned, but has also published new editions of his well-known "Introduction to Geology" and "History of Land Mammals in the Western Hemisphere". He has rewritten the greater part of the latter book and made it an indispensable up-to-date work of reference. Now that he is an octogenarian, he adds to our indebtedness by giving us a stimulating collection of memories, which show how wide may be the outside interests of one who devotes himself to palæontology. ARTHUR SMITH WOODWARD.

PLANT VIRUS DIESEASES

Plant Viruses and Virus Diseases
By F. C. Bawden. (A New Series of Plant Science Books, Vol. 5.) Pp. xii+272. (Leiden: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1939.) 7 guilders.

THE earlier investigations of virus diseases of plants were attempted by the standard methods of the plant pathologists, and failed to reveal the cause of the disease, or to elucidate the nature of the infective agents. These methods have been supplemented by a technique of the widest biological basis, including that used by biochemists and physicists to investigate proteins and other compounds of high molecular weight. The author, with his colleagues, has played a prominent part in the isolation, purification and chemical recognition of nucleoproteins obtained only from infected plants. His hypothesis, freely accepted to-day, considers the nucleoproteins to be the viruses; this forms the theme of his book, which might with advantage have been entitled "Recent Research on the Nature of Plant Viruses". Thus it differs, particularly in outlook but also in treatment, from other recent text-books of virus diseases which are primarily concerned with the economic host plants; this one especially considers the infective agents.

In the introductory pages the author criticizes with acumen suggested schemes of classification or nomenclature based largely on records of host plants infected; in later chapters a classification based on the actions and properties of the viruses is put forward. Such a desirable change can only take place when sufficient knowledge of the viruses is gained; whereas little benefit and considerable confusion may arise from reshuffling an artificial system of nomenclature, the earlier classifications were based on the limited available facts chiefly concerned with the host plants.

Botanical readers, some perhaps less familiar with serological technique, will find these methods described as they are now utilized in virus research. Evidence shows that the viruses are themselves the antigens; for the purer the virus preparation the more active it has proved, and further, a common antigen may be obtained, for example, from plants of tobacco and phlox, infected with the virus causing tobacco mosaic. Crystalline nucleoproteins have given results of the same order, and are now regarded as the antigens specific to virus-infected plants. This is part of the experimental foundation of the author's hypothesis. Serological technique has also proved of value in identification of the viruses and can be used to distinguish strains of the same virus.

Since Stanley (1935) claimed to have isolated the tobacco mosaic virus, much progress has been made in the methods of purification, and the text shows those employed to obtain samples of tobacco mosaic, potato 'X', tomato bushy stunt, and tobacco necrosis viruses. One yield of 80 per cent of the total protein content of the sap expressed from frozen leaves has been claimed to be virus; but in other cases cited, 2 gm. per litre of cell sap are considered to be virus. From healthy plants no such compounds are obtained by similar procedure.

Later chapters deal with the composition of viruses as revealed by chemical analysis—where the phosphorus and carbohydrate derived from the nucleic acid are of vital importance as without such fractions activity is greatly reduced—and with their optical and other physical properties, including crystalline structure studied by X-rays. Estimates of the size of the particles and their molecular weight are included. A brief account is given of the limited work that has been carried out on the physiology of virus-infected plants. The author reviews possible control measures and considers the breeding of resistant varieties to be a slow but promising line of work. Protection afforded by chance or deliberate infection with mild strains, valuable as it is with certain crops, is not considered likely to be of general use; it appears impracticable to 'vaccinate' plants against more than one virus because of the interactions and complications that may ensue.

In the concluding pages attention is focused upon the question so frequently asked by the earlier investigators: Are viruses living organisms? A straightforward definite answer cannot be given. Further knowledge regarding the activities of viruses in living tissues is needed. In the meantime it is necessary to re-examine carefully the criteria applicable to this judgment in the light of the information already known about viruses.

The book forms a readable account of recent brilliant research, the facts are authentically presented, and the literature adequately surveyed. Here and there a few trivial errors in the type have escaped the proof reader's attention; there are several short reiterations in the introductory paragraphs to the chapters. Biologists are deeply indebted to Mr. Bawden for his critical survey of the progress so recently made in this field of research.

YOUTH ON THE PROW IN CHEMISTRY

Young Chemists and Great Discoveries
By Prof. James Kendall. Pp. xvi + 272 + 23 plates. (London: G. Bell and Sons, Ltd., 1939.) 7*s*. 6*d*. net.

IN this book of the Royal Institution Christmas Lectures of 1938–39, Prof. Kendall records how "the youthful breast, inspir'd by truth's bright ray", arrived at some of the most spectacular discoveries in the history of chemistry. Following Ostwald, he divides his youthful paladins into two classes: the romantic and the classical, exemplified by Davy and Faraday. As one would have anticipated, his first lecture was devoted to the romantic Humphry Davy, an ideal subject for such a theme, such an audience, and such a place. Then followed naturally that wonderful example of the age-old story of the master and the apprentice provided by the interwoven careers and contrasting personalities of Davy and Faraday.

Davy carried out his dramatic experiments on the inhalation of nitrous oxide at the age of twenty; at twenty-two he took London by storm through his brilliant lectures at the Royal Institution; at twenty-four he was elected to the Royal Society; at twenty-eight he discovered potassium. Here, then, is a perfect example of the youthful genius in chemistry.

However, like van 't Hoff, who also leaped to fame at the age of twenty-two, Davy had burnt himself out at fifty. Indeed, from Prof. Kendall's examples it seems that if the romantic type be symbolized by Davy's flaming globule of potassium, the classical type may be likened to the candle, about which Faraday lectured so aptly and charmingly to his juvenile auditory at the Royal Institution. Faraday's first important discovery was made when he was about thirty, and the flame of his genius shone clear and steady until he entered into the twilight of a long and fruitful life.

Prof. Kendall's story, always interesting and animated, ranges from Davy and Faraday through Perkin, Couper and Kekulé, Pasteur and van 't Hoff, Arrhenius and the Braggs, Newlands and Mendeléeff, Bohr and Moseley, to the "first young heroine", Madame Curie, and ends across the Atlantic with Robert Hare, Charles Martin Hall and Irving Langmuir (who characteristically took his seat in a row labelled 'Juveniles Only' at Prof. Kendall's first lecture). The narrative thus traverses an extensive field, and Prof. Kendall's clear and easy style enables him to introduce his readers, as he introduced his juvenile auditory, to such complexities as structural formulæ, polarized light, asymmetric molecules, ionization, the classification of the elements, isotopes and radioactivity.

It is difficult to discover flaws in this entertaining story, although on one or two occasions it may be felt that Prof. Kendall shows a little indulgence to his young heroes. Thus, in defending Davy against those who have accused him of vanity and snobbery, Prof. Kendall quotes Dalton's statement: "The principal failing in his character is that he does not smoke." This testimonial to Davy's character becomes less impressive, however, when one refers to Dalton's original letter, which reads: "The principal failing in his character as a philosopher is that he does not smoke." Moreover, it is scarcely fair to one who has been called "the Scotch Faraday" to say that "only the mighty Faraday roused Liebig's admiration" among the chemists he met in England in 1837; for at that time, as Tilden has remarked, "Faraday having long abandoned the pursuit of pure chemistry, the most famous by far among English [that is, British] chemists was Thomas Graham", who certainly won Liebig's high approbation. "I had a very long and agreeable letter from Liebig a few days ago," wrote Graham to his sister Margaret on November 24, 1837, "conveying the information that his University have made me a Dr. of Philosophy *causâ honoris*. . . . He has a grand project of publishing a chemical journal in three languages, to be edited by Liebig, Dumas, and myself."

As Prof. Kendall points out, several famous chemists have been poets, and the youthful Davy was also the subject of anonymous sonnets from fair admirers. We suspect that if Prof. Kendall had not been an eminent chemist he would have achieved fame as a dramatist, if not indeed as an interpreter of the drama. His lectures were rich in dramatic moments and quick changes. His book, too, ends on a dramatic note. As we are about to lay it down we discover that the "young chemist" whose classical features adorn the dust jacket is not Davy as we have hitherto supposed. To our surprise this charming illustration proves to be an early portrait of Albert Edward, Prince of Wales, afterwards King Edward VII, who in his youth received instruction in chemistry from Lyon Playfair at Edinburgh and took part there in the dramatic experiment with boiling lead which is described at the close of Prof. Kendall's book : "the lecturer and his two gallant volunteers in turn passed their hands to and fro through the stream [of white-hot lead], and the final experiment of the 113th course of Christmas Lectures adapted to a juvenile auditory to be given at the Royal Institution was carried to a successful conclusion".

This absorbing account of youthful achievement in the realm of chemistry cannot fail to arouse and hold the interest of readers of all ages. The volume is attractively produced and copiously illustrated with plates and figures. It contains references to many of the experiments and exhibits of the original lectures, and each chapter is provided with a useful bibliography. The book gives rise to sundry interesting reflections. What was the spark causing the tinder of each youthful genius to burst into flame ? Is there still scope in science for the youthful pioneer, in these days of intense specialization and team work ? Would Faraday, with his meagre formal education and elementary knowledge of arithmetic, have been able in this exacting age to break his birth's invidious bar ? These are some of the intriguing questions to which the intelligent reader must supply his own answers. JOHN READ.

GENETICS OF COTTON

The Genetics of Cotton
By Dr. Sydney Cross Harland. Pp. 193. (London : Jonathan Cape, Ltd., 1939.) 10*s*. 6*d*. net.

THE great economic importance of the world's cotton crop has led to marked advances in the genetics of cotton since 1924, when the most valuable New World species of cultivated cotton were found to be tetraploid. The researches of Dr. Harland have occupied a leading place in this development, and the present book is a fitting summary of knowledge regarding the genetics and cytology of the genus Gossypium.

The first chapter, which is devoted to the taxonomy of the group, recognizes eighteen species, while ten others recognized by some authors are reduced to variety rank and two are assigned to other genera. In addition, *Gossypium Robinsonii*, of Western Australia, is insufficiently known and recent efforts to find it in the wild condition have been unsuccessful. Numerous specific names of cottons in the West Indies and South America are regarded as local races of *barbadense* or *purpurascens*.

The fact that four American and three Polynesian species are tetraploids with 52 chromosomes is of fundamental importance for the genetics of the cultivated cottons. The existence of five wild American diploid species, as well as other diploid species in Africa, Asia, and Australia, shows not only the great age of the genus (regarded as Cretaceous in origin) but also serves as the basis for various views regarding the origin and history of the valuable American tetraploids (Sea Island, Upland, etc.). It is evident that these form a younger section of the genus, having been derived, probably as allotetraploids, from diploid ancestors.

The cytological chapter presents the available evidence from chromosome morphology as well as number, and particularly from chromosome pairing in F_1 interspecific hybrids. Supposed constant differences in chromosome size between the Old and New World species have led to the view that the American tetraploids have resulted from chromosome doubling in sterile hybrids between species from these respective original sources. The chromosome sizes in these presumed amphidiploids do not apparently support this view, and Upcott's reinvestigation of the case of *Æsculus carnea* does not show (as is stated on p. 44) that this amphidiploid has 40 large chromosomes derived from one parent and 40 small ones from the other. Nevertheless, although the evidence of chromosome size gives little support to the view that the American tetraploid species came from crosses between Asiatic and American diploids, yet the pairing in F_1 hybrids does support such a conclusion, for certain crosses between Asiatic species and New World tetraploids give thirteen pairs and thirteen single chromosomes. The evidence is not final, but the existence of tetraploids in Polynesia suggests that this condition goes back a long way in the history of the cottons.

The bulk of Dr. Harland's book is naturally devoted to the numerous results of breeding experiments. Several series of multiple allelomorphs are known, some members of which belong to different species, as in red pigmentation, leaf shape and seed fuzz. Several cases of linkage groups have been found, but with the large number of chromosomes it will be a long time before adequate chromosome maps can be constructed.

This book will be indispensable to all those concerned in cotton breeding, and to geneticists, especially for the work on interspecific modifying genes in a group of species the age of which can only be measured in geological time.

R. RUGGLES GATES.

SOME BIOLOGICAL APPLICATIONS OF NEUTRONS AND ARTIFICIAL RADIOACTIVITY*

By Dr. John H. Lawrence,

Radiation Laboratory, University of California, Berkeley

THE biological and medical sciences are being stimulated and benefited by the recent discoveries of the nuclear physicist in a manner similar to that following the discovery of the naturally occurring radioactive elements and the production of X-rays. The nuclear physicist can now induce radioactivity in practically all of the elements, and he can harness a beam of neutrons of intense biological activity. This new wonderland for the biologist has been brought about by such events as the first successful experiments of Joliot and Curie in artificial radioactivity, the discovery of the neutron by Chadwick, the discovery of heavy hydrogen by Urey, and the development of the cyclotron by E. O. Lawrence and his associates.

During the past four years, workers at the University of California have been intensely interested in the biological applications of these products of the physicist, and recently a new medical-biological laboratory dedicated to this study and housing the new 220-ton cyclotron—the William H. Crocker Radiation Laboratory—has been completed in Berkeley. Because of its ability to produce large quantities of the various radio-elements and neutron rays, the cyclotron is the nucleus of this unit. The Laboratory is, however, staffed not only by physicists, but also by chemists, biologists, cytologists, bacteriologists, physicians and radiologists—all of whom are interested in both the fundamental and practical problems concerned with the interaction of radiation and matter. My purpose here is to discuss briefly some of the investigations carried on in this laboratory or in conjunction with it. Unfortunately, there is not sufficient space to discuss the extensive and important work being done in this field in other laboratories.

When Hevesy first used radium D, an isotope of lead, as a 'tracer' of lead movement in plants, the potential value of similar isotopes of elements which are important in physiological processes, such as phosphorus, sodium, iron and iodine, became apparent. These and other radioactive isotopes are now available; and, since they are chemically like their inactive relatives, their radiations simply label or tag them and enable the investigator (with the aid of a Geiger counter) to study their average exchange and distribution in biological and chemical processes, in health and disease. The effect of irradiation on the reaction is avoided by the use of sufficiently small 'tracer' amounts. On the other hand, many of these isotopes may be used as potent sources of radiation if the metabolism of the element in question is not being studied. In Table 1 are listed some of the isotopes that are used in this University. A brief discussion of studies in which these isotopes are employed follows.

Table 1.

Atomic number	Radio-element	Radiation	Half-life
1	Hydrogen (3)	Beta	150–170 days
6	Carbon (11)	Positron and gamma	20·5 minutes
11	Sodium (24)	Beta and gamma	14·8 hours
15	Phosphorus(32)	Beta	14·3 days
16	Sulphur (35)	Beta	88 days
17	Chlorine (34)	Positron and gamma	33 minutes
19	Potassium (42)	Beta and gamma	12·4 hours
20	Calcium (45)	Beta and gamma	180 days
26	Iron (59)	Beta and gamma	47 days
35	Bromine (82)	Beta and gamma	34 hours
53	Iodine (126)	Beta and gamma	13 days

Radioactive hydrogen is written ${}_1H^3$, in contrast to ordinary hydrogen (${}_1H^1$) and heavy hydrogen (${}_1H^2$), and has only recently been discovered by Alvarez and Cornog of this Laboratory. This newly labelled form is used in biological work and promises to become a valuable adjunct to heavy hydrogen, which has been so extensively used in 'tracer' studies. Although radio-carbon has a very short half-life (20·5 minutes), Ruben, Hassid and Kamen are successfully using it in the study of photosynthesis. Leaves of barley plants grown in an atmosphere of C^*O_2 form radioactive carbohydrates†, even when the plants are kept in darkness prior to exposure to C^*O_2. The bulk of the radioactive material found in the plant is water-soluble and does not contain carbohydrate, carbonate, keto acids or pigments. Jenny and Overstreet of the College of Agriculture grew barley in the presence of K* and showed that the intake of ions is not a uni-directional process, but that ions of the same species may move into the root and out of the root at the same time. Stout and Hoagland of the same department, using the radioactive isotopes of potassium, sodium, phosphorus, and bromine, studied their upward movement after absorption by the roots in actively growing willow and geranium plants. They found that when salts are absorbed by roots, some portion enters the xylem within very short periods of time, and is carried rapidly towards the leaves under the influence of transpiration. That the content of radioactivity in the bark as compared with the root is slight indicates that movement of salts in the former is very slow.

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*Based in part on a paper given before Section A (Mathematical and Physical Sciences) of the British Association, given on August 31 and September 1, 1939, at Dundee.

†The radioactive form of an element is denoted by an asterisk.

Mullins, of the Department of Zoology, has investigated the effect of increasing activities of radio-sodium on the penetration of Na^+ into the single-celled alga Nitella. His results show that, below certain activity concentrations, there is no 'radiation' effect, and point out the importance of using low activities in 'tracer' work. Hamilton is making an extensive study of the physiology of the isotopes of sodium, potassium, iodine and other elements, in health and disease. Their rapid absorption and distribution is evidenced by their appearance in the hand a few minutes after oral administration of small amounts. The isotope of iodine is proving to be valuable in the study of thyroid physiology. Hamilton has demonstrated the marked concentration of ingested iodine in the thyroid gland and has been able to photograph the distribution of iodine by placing the excised gland on a photographic film. Anderson and her associates of the Institute of Experimental Biology have found that in adrenalectomized rats a single dose of 'tagged' sodium is rapidly lost, while potassium tends to be retained.

Radio-phosphorus (P^{32}) has been the most extensively used radioactive isotope. The ease of manufacture in the cyclotron and its relatively

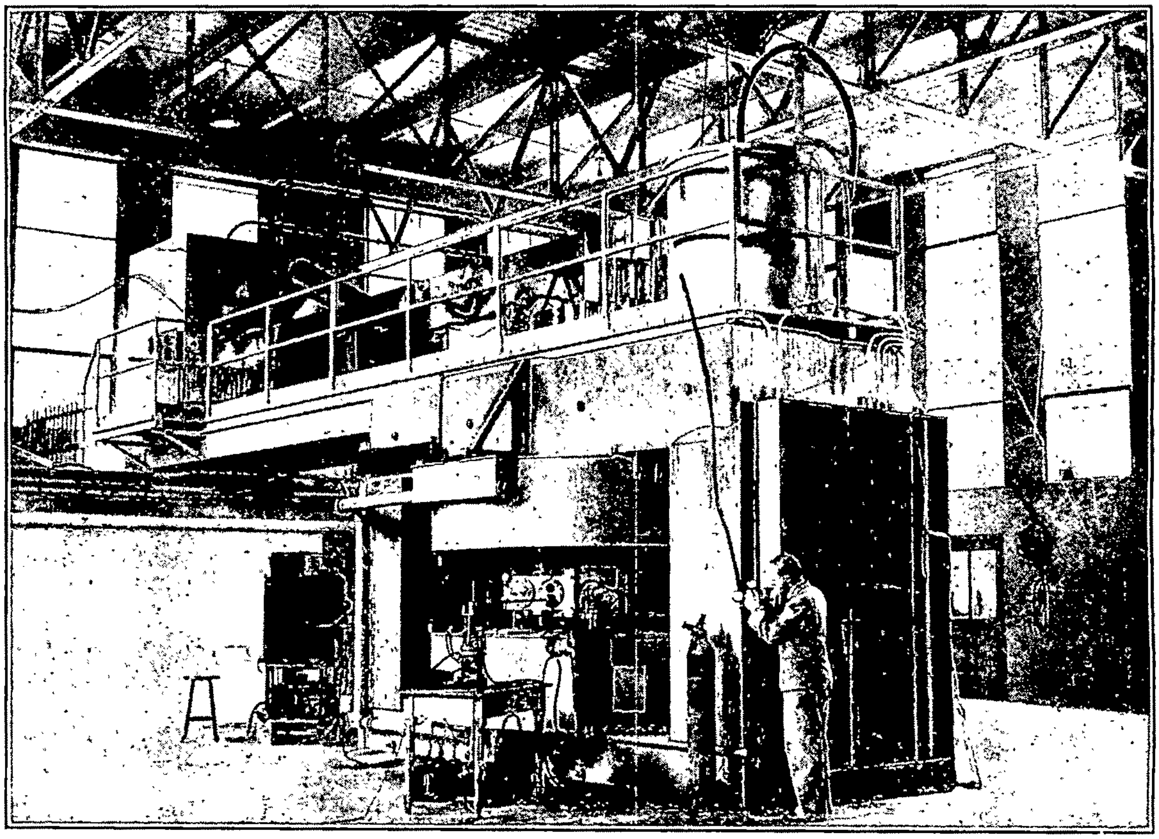

Fig. 1.

THE 200-TON 60-INCH CYCLOTRON IN THE CROCKER RADIATION LABORATORY ON THE BERKELEY CAMPUS OF THE UNIVERSITY OF CALIFORNIA.

Standing by the corner of the magnet and adjusting the helium flow to the target chamber is the late Dr. Harold Walke, of the University of Liverpool. On the table in the foreground is an experimental deuterium generator. The target chamber is behind, marked by the two port holes. Above and to the rear is seen the aluminium oscillator house or radio-frequency power supply. Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

long half-life (14·3 days) make it ideal for biological studies. Chaikoff and his associates in their studies of phospholipid metabolism have shown that various kinds of neoplasms in animals have individual rates of phospholipid turnover, and that cell type does not seem to be the determining factor. In association with Scott and Tuttle, the metabolism of labelled phosphorus in leukæmia in both animals and man is being investigated. The finding that in leukæmic mice the phosphorus turnover is apparently proportional to the degree of leukæmic infiltration suggested the use of radiophosphorus as a source of radiation in the treatment of leukæmia in humans. The concentration of the radio-phosphorus in the areas infiltrated with leukæmic cells tends to localize the therapeutic irradiation (beta-rays). Given by mouth in the form of sodium phosphate, phosphorus is well absorbed (75 per cent) and slowly excreted (2 per cent per day). The turnover of phosphorus in red cells is rapid, whereas the white cells retain it for longer periods of time. Numerous patients suffering from chronic leukæmia are being treated with this material, and in many instances remissions in the disease are obtained.

Tarver and Schmidt, of the Department of Biochemistry, have synthesized methionine from radio-sulphur and, after feeding it to rats, have shown that the radio-sulphur may later appear as cystine extracted from the tissues. Finally, Whipple and his associates at the University of Rochester, in their studies on normal and anæmic dogs, report the following: radio-iron is poorly absorbed by normal animals; anæmic animals absorb iron in proportion to their need for it; plasma is the medium for the transport of iron; the rapid appearance of iron in the red blood cells is spectacular.

The intense beam of neutrons produced by the cyclotron has made it possible to investigate their biological effects on various objects such as bacteria, plants, Drosophila eggs, animal tumours and normal mammals. This new penetrating form of radiation has intense biological effects, even greater than X-rays or gamma rays, on normal and tumour tissue, but when compared with X-rays, selectively affects some tissues more than others. Experiments on animals indicating that neutrons are more destructive to neoplastic tissue than to normal tissue suggested their trial in cancer therapy. In association with R. S. Stone, of the Department of Roentgenology, patients suffering from cancer are now regularly being treated with neutrons from the new 60-inch medical cyclotron. The recent experiments of Kruger in this Laboratory have opened up another possible application of neutrons to cancer therapy. He has demonstrated that cancers from mice placed in non-toxic concentrations of boric acid and irradiated with slow neutrons can be killed with doses of irradiation harmless to tissues not in contact with boron. The slow neutron is captured by the boron nucleus. The combination emits two heavy ionizing particles in opposite directions—an alpha particle and a lithium nucleus—which traverse a distance of about 7 μ in tissue and thus approximate an explosion within the cell.

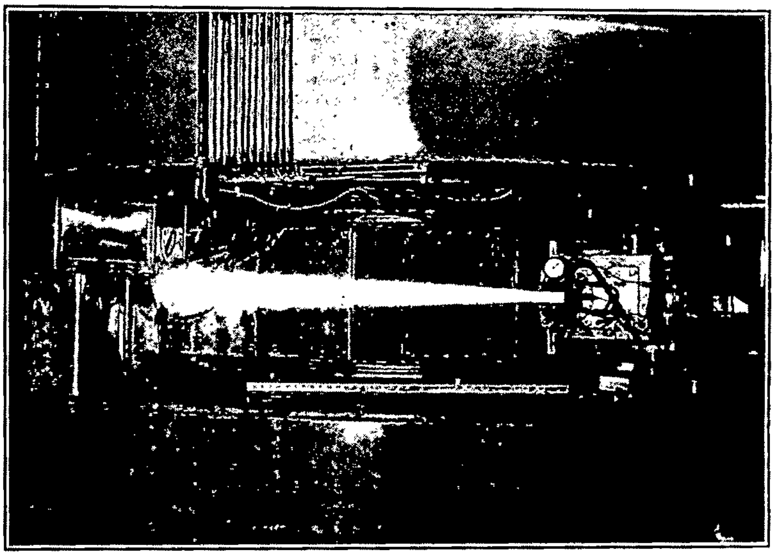

Fig. 2.

THE PATH OF A 16-MILLION ELECTRON VOLT DEUTERON BEAM TRAVERSING THE AIR FOR A DISTANCE OF NEARLY FIVE FEET.

These particles emerge from the vacuum of the target chamber with a velocity of approximately 18,000 miles per second. In slowing down over the course of their path, they give up their energy to the air molecules, causing them to glow with a violet light. However, in practice, a target to be made radioactive is placed at the emergent point of the beam and thus bombarded. Where neutrons are desired the target used is beryllium. Photograph taken by Dr. Donald Cooksey, assistant director of the Radiation Laboratory.

Although the great contribution of the new nuclear physics to the problems of biology and medicine is certainly the 'labelled' or 'tagged' isotope, nevertheless it seems important to pursue the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached.

MOUND EXPLORATION IN THE TENNESSEE VALLEY, U.S.A.

THE operations of the Tennessee Valley Authority in the United States of America, by the erection of dams to collect and control the waters of the Tennessee River and its affluents, will inundate to a considerable depth a vast tract of land, which to the archæologist and the student of the pre- and proto-history of the indigenous peoples of America is one of the most interesting regions of the continent north of the tropics. Unfortunately, in a cultural sense it is still incompletely understood. Though a great part of it, and curiously enough that especially suited to aboriginal pursuits and modes of life, was still unoccupied by surrounding tribes, possibly owing to mutual rivalries, when first visited by the white man in the sixteenth century, nevertheless the whole country abounds in evidence of prehistoric occupation in the form of mounds, shell heaps, stone implements, pottery, old fields, burial caves, and ancient cemeteries. From about 1660 onwards, these vacant lands were occupied successively by Shawnee, Chickasaw, Cherokee and Creeks, with a number of lesser tribes of uncertain affinities.

So early in the history of the Tennessee Valley Authority project as 1933, it was pointed out that the building of the dams and consequent flooding of large areas of the valley would destroy these records of prehistory for all time, unless some plan of conservation could be undertaken. Already the construction of the Wilson Dam, near Florence in Alabama, by the United States Government during the War of 1914–18, had created a lake 23 square miles in area; and to this inundation a further 100 square miles was now to be added. Accordingly, towards the close of 1933, a conference was held at Knoxville which was attended by representatives of the Authority and the Universities of Tennessee and Alabama, with Mr. Niel M. Judd of the Smithsonian Institution as consultant. As a result, archæological surveys of the areas affected were instituted and a number of excavations have been carried out with moneys provided out of Federal funds for the relief of unemployment, with the assistance of grants from universities and other learned bodies. Reports on the results of the survey work and excavation will, for the most part, be published when ready by the Smithsonian Institution of Washington.

Although the existence of a large number of mounds and other prehistoric remains in the great river-valley system, Ohio–Tennessee–Mississippi, of the United States has long been known and their character frequently described and discussed, it is only of recent years, thanks mainly to the work of Mr. Warren K. Moorhead and a small band of enthusiastic investigators, that anything approaching real understanding of the mound-culture has begun to emerge. At the moment, the focus of the problem is the distribution affinities and development of the 'Hopewell' culture, of which outstanding characters appear in what follows.

A more general characterization of the culture of these mounds, however, is given by T. M. N. Lewis, of the University of Tennessee, in a preliminary report to the American Philosophical Society on archæological investigations in the Tennessee Valley during the past five years, to the cost of which the Society had made grants from the Penrose Fund in aid of research[1].

A large quantity of documented archæological material and skeletal remains was obtained, from which the most interesting result to emerge, pending further and more detailed analysis, was the apparent linkage of the aboriginal peoples of Tennessee with those of Middle America. The large earthworks having the form of truncated pyramids, which have now been meticulously excavated, follow in cruder fashion the methods of construction of the temple pyramids of Central American lands, in which the ruins of temple buildings are found to surmount superimposed substructures. Here in Tennessee, however, the substructures are not stone-plated, as they are in the south, but are constructed of clay, whereas the superstructures, in which the religious ceremonies and business of government were carried on, were of poles, bark, cane and clay instead of stone. Elevated square or circular fireplaces constructed from puddled clay are always present in the centre of the floors. Occasionally elevated rectangular platforms and seats of hard-burned clay have been found. Changes in architectural details of the superimposed structures suggest changes in cultural occupations, which, as will be seen, are supported by analyses of the evidence. Stairways or ramps lead to the summits of the structures.

In some instances, although these structures were intended to be the town's chief ceremonial house, interments of important individuals in pits beneath the floor-levels were made. Nearly always these are lavishly accompanied by mortuary offerings of pearl and shell beads, copper ornaments, engraved shell gorgets, and other implements and utensils of bone, stone, shell and pottery.

The villages were small, and only in rare instances could the number of inhabitants have exceeded 1,500 or 2,000 individuals. The huts were small and rude, and in close proximity one to another; the dead were buried either at haphazard throughout the village, as in the Chickamauga Dam Basin, near Chatanooga, or in cemeteries, as in central and western Tennessee.

A detailed report on key positions in the Wheeler Basin of northern Alabama which had been excavated under his direction has been made by William S. Webb, with supplements on the geology and topographic features of the region and their effect on aboriginal occupation, by Walter B. Jones, State geologist of Alabama, a study of the physical anthropology and pathology of the skeletal material by Prof. W. D. Funkhouser of the University of Kentucky, and an analysis of the ceramic material by Dr. James B. Griffin, of the University of Michigan[2].

On the general character of the relation of aboriginal occupation and geological and topographical conditions, it may be said that as a rule the principal villages or settlements with or without mounds were on level ground adjacent to rivers or lakes. Often there is an amazing amount of kitchen midden material in one or more portions of each settlement. In Tick Island, for example, refuse reaches a depth of 8 ft. for an area of nearly two acres. Other examples are the shell mounds, composed of shells, animal bones, stones, pebbles, flint chips, fashioned and broken objects, potsherds, fish remains, charcoal and occasional human burials. Mounds of this type are often so much as 200 ft. wide, 600 ft. long and 15–20 ft. high, with 60,000–100,000 cubic yards content, all left over from primitive kitchens. An archæological map prepared on the basis of material collected in a preliminary archæological survey in 1932 shows 237 sites distributed over six counties. The key sites selected for investigation numbered nineteen.

In general terms, the culture or cultures of these sites, of which the excavation is described *seriatim* in detail, may be characterized on stratigraphic evidence as a sequence. The earliest form is a pre-pottery culture, in which the bow had not come into use. Its place was filled by the *atlatl* or throwing-stick. Spear points appear in great number, associated with a broad-bladed flint knife. Apparently bodies were buried without the flesh, though the occurrence of numerous burnt bones need not necessarily denote cannibalism. Above this from a level of 6–7 ft. below the surface was evidence of a culture in which all burials were in the flesh, and with them were associated marine shells, pottery vessels, and copper. In certain instances burials were in a shell midden containing much flint and many potsherds. Frequently the head was detached and alone buried. It is by no means certain that all the burials in the mounds are of the culture with which they are found.

A burial mound in Tick Island was quite in contrast with other sites in the vicinity, having a number of distinctive cultural traits, which cannot be connected with any other sites or known racial stock. Nothing but pottery, surprisingly, was used, and in quantity, for burial offerings. Some burials were flexed, some extended, but the most common practice was the burial of the detached head. All mortuary vessels were shell-tempered, while detached sherds were all gravel- or sand-tempered. The significance of this will appear later. A very unusual open bowl with much elevated strap handles and rows of protuberances has also been recorded on a number of sites along the Tennessee in north Alabama.

The association of outstanding stone artefacts with copper artefacts, particularly copper reel-shaped objects, leads to discussion of the distribution of these last. The practice of depositing these copper reel-shaped objects in burial mounds is found to centre in a comparatively small area, embracing the counties of northern Alabama. A comparison of the sites produces a very constant complex of thirty-six cultural traits, to which on account of the consistent association of copper, especially the reel-shaped objects, and galena with burials, the name of the 'copper-galena' complex has been given. The people of this culture obtained and worked native copper, buried galena with their dead, possessed many ocean shells, practised ceremonial destruction of artefacts and produced woven fabrics. They were either well on the way towards developing a specialized sedentary culture, or else they represent the degenerate form of a higher cultural complex.

In either event, although neither history nor tradition presents any suggestions for their connexion with tribes who later inhabited this territory, it is noted that they occupied the territory where de Soto (1540) reported the Yuchi to be living; while an examination of the traits here considered to be fundamental in the copper-galena complex leads to the conclusion that it may be regarded tentatively as a manifestation of the Hopewellian phase—a phase centring in the Hopewell culture of Ohio, which was the result of the high development of an able people, who over a long period of time "drew to themselves the best cultural and material wealth from a large area, and like many a metropolis of modern times, radiated a powerful influence on customs and techniques to all less-favoured areas".

The reference to the temper of the pottery of Tick Island calls for further elucidation. In the report on pottery by Dr. Griffin, it is pointed out that the distinguishing characteristic most easily definable in the analysis of the sherds from six sites submitted to him was the type of temper ; it was of primary importance in recognizing and distinguishing the culturally complete ceramic types. As a rule, Dr. Griffin points out, temper is not a reliable diagnostic trait. Yet there is, for example, no evidence that the makers of the shell-tempered pottery had any cultural contact with the users of sand or fibre for tempering. Although pottery containing limestone has contacts with that containing clay or grit, such evidence is lacking for sand and fibre, although both types of pottery occur on the same site.

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[1] "The American Philosophical Society : Year Book, 1938" (Philadelphia, 1939).

[2] "An Archæological Survey of Wheeler Basin on the Tennessee River in Northern Alabama". By William S. Webb. Smithsonian Institution, Washington, D.C., Bureau of American Ethnology, Bull. 122 ; 1939.

INTERGRADING AMONG PLANTS IN RELATION TO THE PROVENANCE OF FOREST TREES

By Dr. R. Melville,
Royal Botanic Gardens, Kew

It has long been known that the geographical source of the seed of forest trees is important if a well-grown and healthy plantation is to be achieved and yield a profitable return. For some years experimental plantations of European Larch have been grown by the Forestry Commission from seed of several Scottish and Continental sources. Attention has been focused to an increasing degree on the question of seed provenance in an effort to obtain varieties capable of giving high yields under a variety of soil conditions in different parts of the country and able to withstand frosts and fungal diseases. With the object of stimulating interest in the question, a discussion on seed provenance and local races of forest trees had been arranged between Sections K (Botany) and K* (Forestry) of the British Association at Dundee, but did not take place before the cancellation of the meeting.

A considerable volume of research on seed provenance in forest trees has been carried out on the Continent, by far the greater part of which has been concerned with conifers, especially Scots Pine, European Larch and Norway Spruce. Much of the work has had a physiological bias. The relationship of seed source to the complex of characters resulting in frost hardiness and the ripening of the shoots has been studied. Rate of growth and growth periodicity are important also and interact on the quality of the resulting timber. Among the morphological characters compared in strains of different origin are the growth habit and the form of the root system, both of which may have a profound influence on the yield under particular conditions, as well as on the form of leaves, buds and cones. It is not possible here to do more than indicate the extent of the wide field already covered by numerous experimenters, but able summaries are given by Langlet[1] and Kalela[2]. The purpose of this article is to point out the relationship between some recent developments in experimental taxonomy and the question of provenance.

The correlations between morphological characteristics of adult trees of different strains and their sylvicultural value so far attempted have been based in the main on the conception of species and varieties as discrete entities, varying but little and more or less easy of recognition. This is a conception related to the classical taxonomy, in which plant forms are often described from one or a few similar individuals. Frequently this is unavoidable, as when the only specimens available have come from a single collecting expedition in isolated or difficult territory. Nevertheless a somewhat static view of the species as an individual results. In settled countries where extensive investigations of the flora have been made, material is available or can easily be obtained for intensive and critical studies of particular species or species groups. Such studies lead to a more dynamic view of a species as a constantly varying population in which the characters of the component individuals intergrade. To enable the foresters to make the most intelligent use of this intergrading, the taxonomist must first produce a classification in which it is embodied. The recent treatment of intergrading is a step in this direction.

Intergrading may occur within a species or between related species capable of interbreeding.

In the case of intra-specific variation, the individuals composing the species can be arranged in an orderly sequence dependent on the gradation of a particular character or group of associated characters. Huxley[3] has proposed the term *cline* for such graded series, with suitable prefixes to denote different types of cline. In connexion with the provenance of forest trees, the kind of cline likely to become of most general interest is that in which the character gradient is related to geographical distribution. For this Huxley proposed the term *geocline*, though *topocline*, as later suggested by Gregor[4], is preferable since 'geocline' suggests a cline dependent on differences of soil. Also, in the future, it may be necessary to use 'geocline' in the latter sense. Huxley quoted as examples of topoclines the intergrading between the wrens of the Shetlands, Fair Isle, the Orkneys and mainland of Britain, with several more among animals, but none in plants. The occurrence of geographical character gradients, however, is probably as common among plants as animals, and little research is necessary to bring them to light. The cedars, for example, form a graded series from west to east beginning with the Atlas Cedar, *Cedrus atlantica*, of the Atlas Mountains, followed by the Cedar of Lebanon, *C. Libani* of the Lebanon Mountains and Cilician Taurus, and ending with the Deodar, *C. Deodara*, of the Western Himalaya. In geographical order the leaves increase in length from west to east, while the number of leaves in each yearly fascicle on the short shoots decreases in the same order (Fig. 1). Hooker, Henry, Dallimore and others considered these forms as varieties of one species, and at the same time retained separate specific names mainly on account of the discontinuous distribution. Continuous variation with geographical gradients probably exists in the European Black Pines, *Pinus nigra* Arnold; the variety in the Pyrenees and Cevennes, var. *cebennensis*, has the longest and most slender needles, the Corsican Pine, var. *calabrica*, has needles of intermediate length and thickness, while the Austrian Pine, var. *austriaca*, has the shortest and stoutest needles of the western European forms. In North America the southern forms of the Shagbark Hickory, *Carya ovata*, have pubescent leaves and branchlets, while forms in the northern United States and Canada are glabrous or nearly so. An examination of the available herbarium material revealed some intermediate forms from the intervening States, and it seems probable that a north to south gradient exists in degree of pubescence in this hickory.

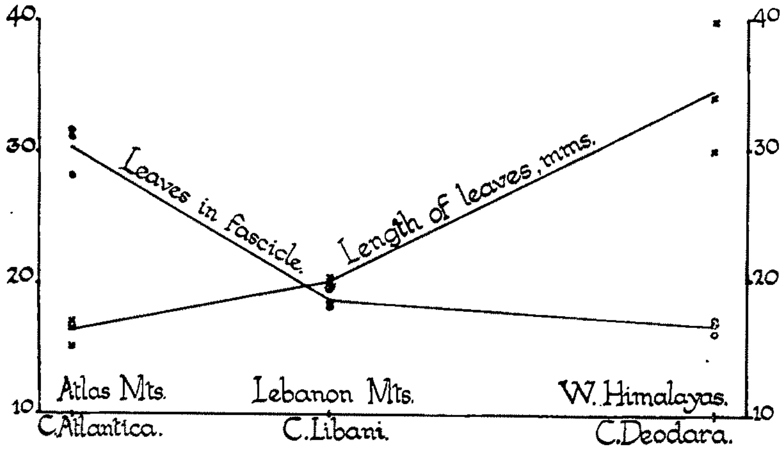

Fig. 1.

TOPOCLINES IN CEDRUS. MEAN CURVES FROM THREE TREES OF EACH FORM, GROWN AT KEW, SHOWING GRADIENTS IN MEAN NUMBER OF LEAVES PER ANNUAL FASCICLE ON SHORT SHOOTS AND MEAN LENGTH OF LEAVES OF SHORT SHOOTS IN MILLIMETRES.

Lindquist[5] mentions a north to south gradient in the leaf shape of the common Wych Elm, *Ulmus glabra* Huds., which in the northern parts of its range in Europe has narrow leaves and in southern parts broad leaves. Field work in Great Britain has confirmed the existence of a north to south topocline in leaf and stem characters in this elm. From Durham northwards spontaneous or subspontaneous individuals bear relatively narrow leaves (ratio of length to breadth 100 : 53–39 or less) and branchlets sparingly pubescent with long internodes. South of the Thames, the common form has relatively broad leaves (ratio of length to breadth 100 : 54–63 or more) and the branchlets are densely pubescent and have shorter internodes. Through the intervening area, forms intermediate in character occur, and there is some intermingling of broad-leaved and narrow-leaved forms as well. Owing to the frequency with which this species is planted, it is not possible to decide whether or no the intermingling of the different forms is a natural phenomenon. Occasional narrow-leaved forms are found in the south and broad-leaved forms in the north, so that it is possible that the proportions of the various forms in the population change in a regular manner from north to south in much the same way as with the bridled and normal forms of the guillemot. There is no doubt, however, of the existence of the gradient in leaf-shape with its associated characters, and a somewhat similar gradient exists in at least one other British species of elm.

Intergrading between species due to hybridization, segregation and backcrossing is well known among plants and gives rise to difficulties for the taxonomist in such genera as Ulmus, Salix and Nothofagus. The intermediate forms normally have a random distribution in the area common to both parents, but they can be arranged in graded sequences analogous to naturally occurring clines by taking advantage of a suitable character, for example, leaf shape in Ulmus. For such an arrangement of hybrid forms, Melville[6] proposed the term *nothocline* and described a nothocline based on the variation of leaf shape in the numerous forms of the hybrid *U. glabra* Huds. × *U. Plotii* Druce. The primary need for a method of classifying hybrid swarms can thus be satisfied. The road is opened for attempts to correlate other characters, such as properties of the timber or resistance to disease, with the variable character on which the nothocline is based.

The arrangement of the individuals composing a species into clines enables the taxonomist to present the data of variation in a form in which it can readily be grasped. The sylviculturist may be able to draw useful conclusions from such data. Thus it is probable that glabrous forms of the Shagbark Hickory are more hardy than pubescent forms, while some at least of the intermediate-leaved forms of the Black Pine are the most desirable sylviculturally. If it proves feasible for the taxonomist to define ecoclines—a gradient related to conditions of the habitat—in woody species, some help may be afforded in the choice of the most suitable form for a particular site. A study of the European Larch on these lines would be useful. Until further work has been done on hybrids, the value of the nothocline remains problematical, though it seems probable that when linkage exists between morphological and sylvicultural characters, it will be revealed by the groupings arrived at in this type of classification. If this proves to be the case, the taxonomist may be able to indicate the best forms for propagation from the numerous wild forms in such hybrid swarms as those connecting the elms, *Ulmus glabra* and *U. Plotii*, and the common pedunculate and sessile oaks, *Quercus Robur* and *Q. petraea*.

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[1] Langlet, O., *Svensk. Skogs. foren. Tidsk.*, 1–2 (1938).
[2] Kalela, A., *Comm. Inst. Forest. Fenn.*, **26**, 1–445 (1938).
[3] Huxley, J., NATURE, **142**, 219 (1938).
[4] Gregor, J. W., *New Phytol.*, **38**, 321 (1939).
[5] Lindquist, B., *Acta Phytogeog. Suecica*, **4** (1932).
[6] Melville, R., *Proc. Linn. Soc.*, **151**, 157 (1939).

OBITUARIES

Prof. C. Białobrzeski

PROF. CZESŁAW BIAŁOBRZESKI, who was recently executed by the German authorities in Poland, came from a family of Polish country squires, settled in the Ukraine. He was born in 1879, when the Ukraine was a province of the Russian Empire. His earlier scientific and academic career was spent in the University of Kiev. Like other selected candidates for professorships he was sent abroad to continue his training. Langevin was the man to whom he chose to be attached. To Białobrzeski, he was the embodiment of the ideal physicist, the man uniting philosophical clarity and vigorous theoretical penetration with fine understanding of experimental work. Białobrzeski was all his life a faithful admirer of Langevin, in spite of a fundamental difference of views in everything but physics.

At Kiev, Białobrzeski held his first two appointments, as *Privat-docent* and assistant professor. After Smoluchowski's premature death, the University of Cracow chose Białobrzeski to be his successor. It was, however, not until a year or two after the end of the Polish-Bolshevik War that many Poles living in Soviet Russia were allowed to leave for Poland. Białobrzeski was among those repatriated. He was appointed professor at the University of Cracow; but a year later he answered the call to the capital. He settled in Warsaw, as professor of theoretical physics in the University, a position which he held until his death.

Theoretical physicist though he was by virtue of his appointment, he could never face being severed from a general physical laboratory. After some struggles, he had a laboratory of his own, well equipped and staffed with talented young people. The work of this laboratory is well known to every specialist in spectrography or dielectrics.

Białobrzeski published few papers. The subjects treated in his papers during his professorship in Warsaw were stellar radiation, absorption and diffusion of light, and dielectrics. His last papers were on cosmic ray bursts and on ionization in liquid dielectrics.

Białobrzeski was a very active member of the International Institute of Intellectual Co-operation, an organ of the League of Nations. Owing to his efforts, and undoubtedly to the keen interest he took in philosophical problems, about thirty leading theoretical physicists from Europe and America were invited to Warsaw by the Institute of Intellectual Co-operation for the purpose of discussing the philosophy of physics. This meeting took place on May 29–June 2, 1938, under the presidency of Prof. Białobrzeski.

He was a member of the Polish Academy of Sciences and several times president of the Polish Physical Society.

M. MATHISSON.

Dr. H. J. Walke

Dr. Harold Walke died in Liverpool on December 21 from the effects of an electrical shock received while working in the Physics Laboratory of the University. He was twenty-eight years of age.

Dr. Walke was educated at the Plymouth Corporation Grammar School and University College, Exeter. He early developed an interest in the growing subject of nuclear physics, and he published in quick succession a number of papers and notes which, while perhaps speculative and uncritical, revealed a fertile mind and a very fresh enthusiasm. In 1935 he was awarded a Commonwealth Fund fellowship and this gave him his first opportunity for experimental work in nuclear physics. He proceeded to the Radiation Laboratory, Berkeley, where he worked for two years under the direction of Prof. E. O. Lawrence. [Dr. Walke appears in the illustration of one of the Berkeley cyclotrons on p. 126 of this issue.] He published a number of excellent papers on artificial radioactivity produced in elements from potassium to vanadium.

Walke returned to Great Britain in 1937 to work in the Physics Laboratory, Liverpool, and in 1938 he was awarded an 1851 Exhibition senior studentship. He helped in the construction and operation of the cyclotron and, in addition, he continued his investigations into the activities induced in scandium, titanium and neighbouring elements, making some interesting discoveries in connexion with nuclear isomers and with the process of electron capture. He spent the summer of 1939 in Berkeley and returned in December with much work in hand and full of plans for the future. He had before him a career rich in promise, and his death at so early an age is a great loss to physics. Friendly and unassuming in manner, yet full of a vigorous and burning enthusiasm for his work, Walke was a delightful colleague. He is mourned by many friends both here and in the United States.

Mr. Douglas H. Baird, C.B.E.

Douglas Heriot Baird, managing director of Messrs. Baird and Tatlock (London), Ltd., died on January 3, at fifty-six years of age. The direction of such a business implies a wide knowledge of laboratory practice and of scientific progress. Mr. Baird was well endowed in these respects by virtue of education at Charterhouse, University of London and Karlsruhe (under Engler), and also by twenty-seven years' experience in the business, nineteen in succession to his father, the late Mr. Hugh Harper Baird, who founded it in 1879.

The business being world-wide, Mr. Baird travelled extensively—Canada, the United States, India, Ceylon, Burma, etc.—believing that requirements peculiar to overseas trade can only be properly satisfied by an intimate acquaintance with the local conditions. In these countries, and in those of Europe, Mr. Baird had many friends, and it is safe to say that he met at one time or the other almost every well-known director of a laboratory. During the War of 1914–18, Mr. Baird, besides running a poison gas filling factory, did important work in connexion with field laboratories. He designed the first mobile bacteriological laboratory sent out to France, and was responsible for the improvements in this, and the planning of other special laboratories for the use of the Army Medical Service of the Allies. He was created a Commander of the Order of the British Empire for his services.

After the War, Messrs. Baird and Tatlock became associated with Messrs. Hopkin and Williams, Ltd. A complete new series of the well-known catalogues were issued and the works at Walthamstow were rebuilt. During the past year a six-story annex to their warehouses in Cross Street, Hatton Garden, E.C. has been erected. One floor of the new building is occupied by laboratories of the company's own design and construction.

The work carried out in these laboratories comprises the testing of apparatus, chemicals and materials for laboratory construction; preparation of standard solutions, microscopic stains, indicators, and special reagents; research in chemical manufacturing methods; and the preparation of some of the rarer chemicals (chiefly organic). Special attention is being devoted to the last-named section, which has already turned out a large number of new products, some of which have not previously been obtainable in Great Britain.

Last year a new branch of the firm was opened in Calcutta to deal with increasing trade in the East, and in England the Hopkin and Williams' chemical side has been developed by building two research laboratories in Cross Street, and one semi-industrial research laboratory which is a liaison between the investigating laboratory and the work for elaboration of new processes.

Mr. Baird was chairman of the British Chemical Ware Manufacturers' Association, this year being his twelfth in office, and a member of the Standards Committee of the Institute of Chemistry, and of a number of other bodies associated with scientific affairs and apparatus.

We regret to announce the following deaths:

Mr. J. E. Dowson, known for his work in connexion with producer gas, on January 3, aged ninety-five years.

Prof. L. Hopf, professor of applied mathematics in the University of Aachen until 1933, on December 21.

M. Max Laubeuf, member of the Section of the Applications of Science to Industry of the Paris Academy of Sciences, a pioneer in the development of the modern submarine, aged seventy-five years.

Mr. Reginald A. Smith, keeper of the Department of British and Medieval Antiquities in the British Museum during 1927–38 and director of the Society of Antiquaries, on January 18, aged sixty-six years.

NEWS AND VIEWS

Dr. C. H. Desch, F.R.S.

PERHAPS the outstanding characteristic of Dr. C. H. Desch, who retired from the post of superintendent of the Metallurgical Department of the National Physical Laboratory at the end of last year, was the astonishing—possibly unique—breadth and depth of his scientific knowledge and interests. Educated at the Finsbury Technical College, the University of Würzburg and University College, London, as a chemist, he entered the Metallurgical Department of the last institution in 1902. From 1909 until 1920 he was at the University and Royal Technical College, Glasgow. In 1920 he was elected to the chair of metallurgy in the University of Sheffield, a post which he held until 1931. Thus from 1902 until 1931 he was almost continuously engaged in metallurgical teaching and research.

Although primarily a metallographer, Dr. Desch's knowledge of the more practical aspects of metallurgy is wide, and his contributions to discussions are invariably welcomed by those engaged in industry. Alongside his metallurgical work, however, Dr. Desch has retained his interests in every branch of chemical advance; but the chemistry of cements and concrete, the intermetallic compounds, and the crystalline state in general have claimed his chief attention. The respect in which his scientific abilities have been held may be gauged by the variety of offices which he has filled. From 1926 until 1928 he was president of the Faraday Society; during the winter of 1931–32 George Fisher Baker lecturer in the University of Cornell, while at present he is president of the Institute of Metals and vice-president of the Iron and Steel Institute. Dr. Desch is now scientific adviser to the Iron and Steel Research Council.

Dr. C. Sykes

As chemistry was the avenue which led Dr. Desch into the field of metallurgy, so, in the case of Dr. C. Sykes, his successor as superintendent of the Metallurgical Department of the National Physical Laboratory, has physics functioned. After graduating in science in the University of Sheffield in 1925, Dr. Sykes spent one year carrying out research in physics under Prof. R. S. Milner. After obtaining the degree of M.Sc. in 1926, he entered the Metallurgical Department under Prof. Desch as a Metropolitan-Vickers research scholar. Two papers on the alloys of zirconium published in the *Journal of the Institute of Metals* in 1928 and 1929 appear to represent the first fruits of his work as a metallographer.

Since 1928, Dr. Sykes has been connected with the research organization of Messrs. Metropolitan-Vickers Electrical Co., Ltd., being engaged at first on work on high vacua, thermionic valves and X-ray tubes. About 1934, under the influence of Prof. W. L. Bragg, he began to publish in the *Proceedings of the Royal Society* and the *Journal of the Iron and Steel Institute*, and later in the *Proceedings of the Physical Society* and the *Journal of the Institute of Metals*, a remarkable series of papers on the super-lattice, the order-disorder change in β-brass and other alloys, on the supposed low-temperature critical points in iron and steel and on age-hardening. Some sixteen papers, all of real importance, represent the contribution which Dr. Sykes has made in little more than five years to that field of knowledge which is concerned with the physics of the metallic state.

Baron Richerand (1779–1840)

BARON BALTHASAR ANTHELME RICHERAND, a famous French surgeon, was born at Belley in the Ain Departement on February 4, 1779. He studied medicine in Paris, where he qualified in 1799 with a thesis on fractures of the neck of the femur, and two years later published his "Nouveaux Élémens de Physiologie", which met with a remarkable success and went through thirteen editions and was translated into seventeen foreign languages. In 1802 he was appointed assistant surgeon to the Hôpital Saint-Louis, where he later became surgeon-in-chief. In 1805 appeared his "Nosographie et Thérapeutique chirurgicales" in three volumes, of which the sixth edition was published in 1821. In 1807 he was made professor of surgical pathology in the Paris medical faculty, where he continued to lecture for more than thirty years.

In acknowledgment of the care which he had bestowed on the Russian and German wounded in 1814 in the Hôpital Saint-Louis, which had become converted into a huge ambulance, Richerand was made Commander of St. Anne and Knight of St. Wladimir by the Emperor of Russia and received the Military Order of Frederick from the Grand Duke of Baden and a gold medal from the King of Prussia. In 1824 he was appointed surgeon to Louis XVIII and in 1829 hereditary baron for his services to science and humanity. His minor works included "Des erreurs populaires relatives à la médecine" (1810) and "Histoire des progrès récents de la chirurgie" (1825). He also wrote notices of Bordeu, Cabanis, Brillat-Savarin, Ambroise Paré, etc., and a large number of articles in the "Dictionnaire des sciences médicales", *Mémoires de la société d'émulation*, *Bulletin de la Société philomathique, etc.* He died on January 23, 1840. A posthumous honour was paid to him in 1851 when the Avenue Saint-Louis was renamed after him.

Utilization of Scientific Research during War

IN the House of Lords on January 18, Lord Strabolgi asked the Government questions on the methods being adopted to examine 'war inventions',

(*Continued on page* **143**)

NATURE

SUPPLEMENT

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SHORT REVIEWS

BIOLOGY

The General Aspects of the Vegetation of Europe

By Marietta Pallis. Pp. iv + 66. (London: Taylor and Francis, Ltd., 1939.) 3*s.* 6*d.* net.

IN this essay, Miss Pallis endeavours to assess the various factors which have determined the character of the existing vegetation of Europe. She naturally places in the foreground the climatic factors, particularly the rainfall, which according to Schimper governs the development of woodland and grassland respectively. For Europe, with its comparatively abundant rainfall, woodland should be dominant. But this dominant vegetation which Miss Pallis calls primitive has been considerably modified by the action of animals and man, both in historic and in prehistoric times. Miss Pallis thinks that Schimper did not appreciate sufficiently the enormous effect of such action, to which he only refers incidentally. The fact that much of the present vegetation of Europe is of a secondary or degenerate type caused by animal and human interference seems to the author to be of far-reaching importance.

Farrow's experiments on the vegetation of the Breckland have demonstrated the modifying effect of rabbits, and Miss Pallis in her essay directs attention to many other instances of the change in vegetation produced by man and domestic animals, particularly goats, in other parts of Europe—Thessaly and Greece being especially chosen as examples.

But apart from what is going on at present, Miss Pallis indicates that such changes may have been occurring for an indefinite length of time, long before human interference occurred. The disappearance of the forest covering the greater part of Europe began gradually, she believes, with the appearance of herbivorous animals and gained in speed towards the end of the Tertiary period, when the grazing horse took the place of the browsing horse. The appearance of these horses coincides with the progressively falling percentages given by Mrs. Reid and Miss Chandler for the woody plants of the Tertiary.

In a table at the end of the publication, Miss Pallis sets out clearly some of the facts on which she bases her conclusions. Her essay, in which a great many facts have been gathered together, both from her own observations and from those of others, gives much food for reflection, and should be carefully studied by all ecologists and plant geographers.

Wild Chorus

Written and illustrated by Peter Scott. Pp. x + 120 + 68 plates. (London: *Country Life*, Ltd., 1939.) 21*s.* net.

THE pictures take the stage in this attractive book, and the text makes an appropriate background. The writing is simple and direct, and whether the author takes us after geese in the mud-flats of the East Anglian coast, on the plains of Hortobagy, on the Black Sea or in Persia, or merely describes the return of Annabel or Barnacle Bill, or the punting risks encountered at the railway bridge, he manages always to convey a sense of adventure and a feeling of enthusiasm in his exploits.

Few artists have been able to catch the attitudes and colour patterns of birds without losing spontaneity by paying too great attention to feathers; but Peter Scott has this gift. He is too familiar with his ducks and geese to miss their particularities, and his fine appreciation of design and of the effect of masses of light and shade are strikingly shown in such pictures as "Pink feet paired", "Blue Sky and Snow Geese", and "Four Teal". The colouring varies considerably in quality: among the most successful are "La Toilette", a picture of two pink-footed geese upon wet sand, "Garganeys in Spring", and the subdued yellows and greys of "Geese moving from Stubble to Potatoes". But in some, while the action and grouping of the birds themselves are beyond criticism, the treatment of clouds and water is harsh and the colours strong even to hardness. There are two fine sepia reproductions of water-colour drawings, flamingoes and Caspian pelicans, and the quality is so delicate that one could have wished that a coloured plate had been spared for a water-colour.

An odd mis-spacing occurs in the legend of the plate facing p. 10, "BRENT GEESE COMING OFF THE ZO STERA", which suggests an exotic lake rather than a common water-weed.

To anyone who delights in lively narrative and in the colouring, action and groupings of geese and ducks in the air or on water or land, this work will afford great pleasure. JAMES RITCHIE.

A Book of Roses

By J. Ramsbottom. (The King Penguin Books.) Pp. 30+16 plates. (Harmondsworth: Penguin Books, Ltd., 1939.) 1*s.* net.

THIS charming little book reproduces most excellently in octavo size sixteen coloured plates by that master of botanical portraiture Pierre Joseph Redouté, whose magnificent three-volume work "Les Roses" was published in thirty parts between 1817 and 1824. In addition to the exquisite reproductions, there is for each of the roses figured a short account giving botanical and horticultural information.

Of Redouté himself there is a good account. His career is full of interest. Shortly before the French revolution he came over to England to learn the English methods of stipple engraving not then used in France.

The major part of the text of the "Book of Roses" is devoted to the history of this queen of flowers. The earliest known European representation of the rose is found in the House of Frescoes at Knossos, dating from the middle of the sixteenth century B.C. The ancient coins of Rhodes had figures of roses, which flower gave the name to the island. Herodotus and Theophrastus, the father of botany, both give accounts of the rose. From these early representations and descriptions of the rose through Roman and medieval times to the present day, Dr. Ramsbottom follows up carefully and delightfully the history of the rose. His very readable and informing text seems to refute a passage of Walter de la Mare:

> . . . . . . "No man knows
> Through what wild centuries
> Roves back the rose".

The "Book of Roses" is sure of a warm welcome, and the publishers are to be congratulated on their production of this most charming little book.

The World of Plant Life

By Prof. Clarence J. Hylander. Pp. xxii+722. (New York: The Macmillan Company, 1939.) 32*s.* 6*d.* net.

PROF. HYLANDER, in his preface to this volume, says that it was "planned and written with the specific purpose of making the layman familiar with a few of the interesting plants, both native and introduced, which are found in the United States". He has purposely avoided using unnecessary technical terms, and has written throughout in a style that will appeal to the non-scientific reader. Indeed, in some instances he is perhaps too lax in his statements, as when he says in his preface that "Gardening is a fundamental instinct", a view that few psychologists would support!

After an introductory section on the whole plant kingdom, Prof. Hylander works step by step through the various groups, commencing with bacteria, and following more or less the system of Engler. As end-papers there are phylogenetic 'trees' showing the supposed lines of plant descent from fission plants to palms and pinks. It is perhaps a pity to include these in a popular work, as many readers will assume that such trees rest on a firmer foundation than is actually the case. This is especially so if Engler's system is used, as Engler himself was definitely sceptical regarding its phylogenetic basis.

Under each family Prof. Hylander mentions a number of genera and species of special interest to American readers, and the information he gives will undoubtedly provide a useful scientific background for the study of American vegetation, both native and introduced.

The illustrations are excellent, and special mention should be made of the attractive silhouettes at the head of each part.

Looking at Life

An Introduction to Biology. By A. M. S. Clark and G. Buckland Smith. Pp. xvi+224. (London: J. M. Dent and Sons, Ltd., 1939.) 2*s.* 6*d.*

THE cinema has now come to be regarded as a valuable tool in the construction of a biological education. The visual images that the viewer carries away with him are necessarily more stimulating and dynamic than the static photographs of text-books. But the transitory character of a film-showing has a disadvantage in that if a mistake in visual memory is made by a pupil it may well persist, so that the aim of the authors of "Looking at Life" in supplying an elementary book which could be used as a complement to the already available biological films is admirable.

Unfortunately, the text of the book contains little more than a potted version of the more rigid university botany and zoology courses and is scarcely suitable to serve as a first course in biology. Animal and plant types are described in a manner completely unrelated to any local environmental conditions, so that a syllabus based on this book would be, at least with regard to the animals, almost entirely theoretical, or would have to rely largely upon museum specimens. Better use of already existing films would have been made if the framework had been constructed around representative types of freshwater and terrestrial forms which are likely to be available. The text itself is a strange mixture of clarity and obscurantism, while the complete omission of gymnosperms is peculiar in a book where all the other main plant phyla are described.

CHEMISTRY

Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 1: Electrochemical Theory. Pp. viii + 134. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 4*s*. 6*d*. net.

THE preface states that this, the first of two volumes, deals with general principles, the second volume being planned to be a guide to modern methods of gravimetric electroanalysis. The present volume provides a clear and sound introduction to electrochemistry and covers all the theoretical matters which will arise in the practical part, some of which are not very well explained in other books. The section on transport numbers is good and the concentration changes at electrodes dealt with in Chapter vii are clearly explained. The modern theory of electrolytes is briefly yet adequately dealt with, but it is unfortunate that both the equations given on p. 64 are incorrectly printed. Some expressions are peculiar; for example, on p. 57 the 'valency of a reaction' is mentioned, and the system of numbering of the equations is sometimes rather puzzling. The book will be particularly useful to analysts who have to use the electroanalytical methods and have not kept up to date in electrochemical theory, whilst all students will welcome the concise and clear way in which the principles of the subject are discussed.

Aids to Organic Chemistry

By Stanley F. Smith. (Students' Aids Series.) Second edition. Pp. viii + 120. (London: Baillière, Tindall and Cox, 1939.) 3*s*. 6*d*.

THE second edition of this useful little work has been revised, the sections on sugars and complex aromatic compounds have been re-written to bring them up to date and give the modern ideas on their structural formulæ, and the index has been enlarged. The author, however, has been careful not to expand the text so as to change the character of the book. The volume provides a concise summary of organic chemistry which will be very useful to medical students in the preparation and revision of the subject, and it is a useful supplement to text-books which deal with the topics in more detail.

The Economics of Chemical Industries

By Dr. Edward H. Hempel. Pp. ix + 259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 15*s*. net.

IT is regarded at least as important to be able to sell an article as to make it: indeed the salesmen are more highly remunerated than the technical workers. Whilst personality is the greatest asset for a salesman, there is growing up a science of salesmanship and management which is evidenced by the increasing number of books dealing with various aspects of the subject.

This particular one seeks to portray the characteristic background and the economics common to the American chemical industries. It is very informative and will be of great value in its country of origin and of interest elsewhere to firms which have business connexions with the American chemical industry. It deals largely with legislation, foreign chemical trade, and financial policies, and contains a considerable amount of statistical matter. A similar volume based on British customs would have wide appeal.

ENGINEERING

(1) Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp. xxviii + 1019. 35.80 gold marks.

(2) Schrifttumsverzeichnis zum Lehrbuch der Hochfrequenztechnik

Von Dr. Fritz Vilbig. Zweite verbesserte und erweiterte Auflage. Pp. iv + 172. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 8 gold marks.

THE publication of Dr. F. Vilbig's monumental text-book on high-frequency phenomena two years ago provoked expressions of general and well-merited approval, for it was clear that its author had successfully attempted the difficult task of surveying, in up-to-date fashion, a field already extensive and yet expanding. In particular was his effort commended for the judicious balance of his selection of material, old and new. Two years is a long time in wireless history, so that it is not at all surprising that Dr. Vilbig has already been obliged to undertake the preparation of a second edition (1) of his book. The changes made are naturally mainly by way of additions, the chapters being expanded on the average by a fifty per cent increase of text, though naturally the expansion is relatively greater in the case of such swiftly developing subjects as the study of wave propagation and television. An entirely new chapter on modern acoustics has, however, been added at the end of the book.

In Dr. Vilbig's first edition a most comprehensive and up-to-date bibliography of books and original papers occupied no less than a hundred pages. In view of the expansion of the main text in the second edition, it has become necessary to publish this bibliography as a separate volume (2), which is, of course, correspondingly enlarged and brought up to date.

Radio Interference Suppression

By G. W. Ingram. Pp. viii + 154. (London: The *Electrical Review*, Ltd., 1939.) 5*s*. net.

IT is not often that one branch of applied science reacts so unfavourably on another branch, and the difficulties which have arisen from the interference from power circuits and apparatus in the prevailing types of radio-receivers were scarcely anticipated. The problem assumed international magnitude, and has only within the last few years been brought down to a qualitative basis. Meanwhile the British Post Office has been investigating and advising on tens of thousands of cases per annum, and it is to them that we owe the idea that the interfering radio currents travel along power and other mains longitudinally, that is, along the wires in parallel; indeed, the impedance to earth of such mains may be megohms, thus conserving the disturbing energy. The variegated field has now been sorted, and a very complete guide offered by the present author, whose firm has been in the forefront, both in theory and practice, of interference suppression. In principle the methods are simple, the application of condensers to earth, with or without appropriate chokes, being most general; the economic design of units and their proper location, however, requires systematic thought. Much of the author's information is usefully tabulated. L. E. C. H.

Applied Acoustics

By Dr. Harry F. Olson and Frank Massa. Second edition. Pp. xviii + 494. (London: Constable and Co., Ltd., 1939.) 25*s*. net.

AMONG the most important applications of science in commercial engineering is sound-films, and the Radio Corporation of America, which has the services of the authors in high executive capacity, has always shown initiative and independence of the Western Electric, its major competitor, in improving sound recording and reproduction both as a whole and on the scale demanded by cinema-goers. The new edition is a somewhat expanded version of the first edition, with the necessary sections brought up to date. The text is most readable and remains the best summary of technical applications of what was long considered to be an academic scientific subject. The side-issues are many, including the measurement of noise, the control of transmission of sound vibrations through building structure, much physiological acoustics, and sound-signalling. The print and diagrams are both excellent. L. E. C. H.

GEOLOGY

Outlines of Historical Geology

By Prof. Charles Schuchert and Prof. Carl O. Dunbar. Third edition, entirely rewritten. Pp. v + 241. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 12*s*. 6*d*. net.

THIS book provides a summary of geological history; but it must be stated at once that this history has special reference to North America, since mention—and that brief—is made of only a few non-American topics or examples. It is not intended for the specialist, its aim being to provide a short general survey of earth-history. As the authors say, their intention is to bring into relief the high lights of this history, and this they certainly succeed in doing.

The story is presented in four parts, the first dealing with the nature of the evidence, the second with the physical history and the third with the history of life. The sections concerned with the later episodes of geological history have deliberately been made fuller than usual in a book of this size, this added detail leading up to the fourth part of the book, in which man's geological history is considered The account of the evolution of mammals, includin man, is especially well done. As usual in America text-books, the illustrations are abundant and mostl excellent; a few mistakes have been noted—fo example, there are no Tertiary lavas in the Orkneys

This is an excellent book for a geology studen desiring a summary of North American historica geology, or for the general reader in search of refreshing but authoritative account of the marvellou pageant of life revealed by palæontology.

Geology for Engineers

By Brig.-General R. F. Sorsbie. New edition. Pp xxii + 348. (London: G. Bell and Sons, Ltd., 1938. 12*s*. 6*d*. net.

THE first edition of this book was published in 1911, and while the same general arrangement is retained in the new volume, the former chapters on historical geology have been omitted and the section on applied geology extended, so that it now forms nearly two-thirds of the book. No new illustrations are used, all the diagrams being taken from the old edition. Much material is quoted direct from other authors, and modern treatment of subjects such as clays and soils is lacking. The bibliographies which are given with various chapters would be improved by the inclusion of fuller details and dates; the titles of works published more than sixty years ago could well be replaced by those of more recent text-books.

MATHEMATICS

Elliptic and Hyper-elliptic Integrals and Allied Theory

By the late W. R. Westropp Roberts. Pp. viii + 311. (Cambridge: At the University Press, 1938.) 12*s*. 6*d*. net.

WILLIAM RALPH WESTROPP ROBERTS was the eldest son of the senior fellow of Trinity College, Dublin, and after a brilliant career as a student in which he gained most of the important prizes in the Mathematical School, he was elected to a fellowship at his father's college in 1882. During the remainder of his life he made many noteworthy contributions to mathematics and in later years planned to publish a work embodying his researches. The present volume is the outcome of that aim, but unfortunately, the author did not live to complete his work.

The text is divided into six chapters, the first of which is devoted to some necessary theorems in algebra. Then follows a lucid discussion of some elementary integrals upon which the more general integral is shown to depend. In this chapter, a very interesting and valuable analysis is given of the function $R(z, n) \equiv d\chi/dz - d\chi/dn$, where χ denotes $A_0\{f(z) - f(n)\}/(z - n)$, which is essential to the development of the subsequent theory. Chapter iii is devoted to algebraic equivalents and Abelian transcendents. The text then passes to Abelian or hyper-elliptic integrals, in which there is a clear investigation of their periodicity. Finally, Chapters v and vi are concerned with the particular cases in which $m = 2$, giving rise to elliptic integrals and functions, and $m = 3$ of the general polynomial $f(z)$ which occurs under the square root in the denominator of the integrand. Each chapter closes with a set of examples for the student's use, and among these may be found some important theorems.

It is evident that the work is not complete as there are several references to Chapter vii and the figures contained therein, but this chapter was never written nor were the diagrams drawn. In spite of this, however, the book is not only a striking essay in mathematical analysis, but is also a notable contribution to the subject. F. G. W. B.

Étude critique de la notion de collectif

Par Prof. Jean Ville. (Monographies des probabilités, Fascicule 3.) Pp. iv+144. (Paris: Gauthier-Villars, 1939.) 75 francs.

THERE are many ways, none altogether satisfactory, of defining probability, but roughly speaking, these fall in two groups, namely, those based upon the 'equally-likely' concept of Laplace, and those based on the concept of frequency. In recent years the frequency method has been greatly developed by von Mises, who introduced the notion of a *collective*. This is defined as a mass phenomenon or an unlimited sequence of observations such that the relative frequency of a particular attribute tends to a fixed limit unaffected by any place selection or gambling system. The probability of the attribute in the given collective is then defined as this limit. It is claimed that this treatment avoids the logical difficulties inherent in Laplace's method.

M. Ville makes a careful analysis of the ideas of von Mises, and also of those of Reichenbach, Popper, Copeland and Wald, who have put forward closely related theories. The conclusion is that the idea of a collective, though roughly what is needed, is too rigid. In particular the use of the word limit, in the strict mathematical sense, either leads to results which are inconsistent with themselves, or at best necessitates a set of artificial restrictions which are really alien to the nature of the problem. A satisfactory definition of probability has not yet been found. H. T. H. P.

Orthogonal Polynomials

By Prof. Gabor Szegö. (American Mathematical Society, Colloquium Publications, Vol. 23.) Pp. ix+401. (New York: American Mathematical Society, 1939.) 6 dollars.

ORTHOGONAL polynomials were first studied in connexion with a certain type of continued fractions, bearing the name of Stieltjes. They are closely related to problems of interpolation and mechanical integration, and recently have come into prominence in connexion with mathematical statistics and quantum mechanics. They are also connected with trigonometric, hypergeometric, Bessel, and elliptic functions, and occasionally occur in the theories of differential and integral equations. The present book is the first in the English language on the subject, and indeed the first extensive treatment of the subject in any language. It deals both with special orthogonal polynomials, such as those of Jacobi, Laguerre, and Hermite, and also with the general theory. In particular, there is an account of recent investigations of the distributions of the zeros, of asymptotic representations, of expansion problems, and of certain questions of interpolation and mechanical integration. Some of the results not previously published are due to the author himself. The book concludes with a set of sixty problems, a bibliography, and an index. H. T. H. P.

Mathematical Tables

Vol. 7: The Probability Integral. By W. F. Sheppard. Completed and edited by the Committee for the Calculation of Mathematical Tables. (Published for the British Association for the Advancement of Science.) Pp. xi+34. (London: Cambridge University Press, 1939.) 8*s*. 6*d*. net.

THESE tables are concerned with the values, from $x = 0$ to $x = 10$, of the functions

$$F(x) = \frac{1}{\sqrt{(2\pi)}}\int_x^\infty \exp(-\tfrac{1}{2}t^2)dt,\ z_x = \frac{1}{\sqrt{(2\pi)}}\exp(-\tfrac{1}{2}x^2).$$

Tables I and II give the ratio $F(x) : z_x$ at intervals 0·01 and 0·1 for x and to 12 and 24 decimal places respectively.

The remaining four tables give natural and common logarithms of $F(x)$. Interpolation is facilitated by the tabulation of derivatives or differences.

The Committee's amplification of Sheppard's work consisted in the completion of Table I and the computation of Table VI.

"The Committee believe that the completion and publication of his tables of the probability integral constitute just that memorial to Sheppard's unsurpassed labours in the field of Mathematical Statistics, which he would himself most greatly have appreciated."

METEOROLOGY

The Drama of Weather

By Sir Napier Shaw. Second edition. Pp. xiv+307. (Cambridge: At the University Press, 1939.) 10*s*. 6*d*. net.

IT is evidence of the growing interest in meteorology that this book should within five years have been reprinted and have now reached a second edition, enlarged by the addition of two chapters with the titles "Where our Rain Comes From" and "Chapter and Verse for Weather in Relation to Agriculture".

The added chapters carry on the happy traditions of the previous portion, the fresh and picturesque language, the concrete as opposed to the abstract statement, and the use of ingenious diagrams containing data that other writers have not attempted to embody. Such diagrams bring into prominence facts which might remain unnoticed if their discovery depended on a severe study of columns of figures; for example, Fig. 93 (p. 258) reveals at once that in the British Isles places fully exposed to the west winds have much heavier rain in winter than in summer, while on the east coast rainfall is more evenly distributed through the year. The author loves a paradox and a note of interrogation regarding widely prevalent ideas. In the first of the new chapters he is certainly successful in stimulating thought when he defends the idea that the pressure distribution is produced by the winds, not vice versa.

The chapter on agriculture contains a number of interesting diagrams. It includes a discussion of the calendar, though it makes no mention of the widely supported World Calendar in which the year consists of four quarters each of three months or 91 days, beginning on a Sunday; in it the 365th day is inserted between December and January.

The book is strongly recommended, to meteorological specialists and laymen alike, for its wide range of appeal, historical and artistic as well as scientific. G. T. W.

Meteorology for Aviators

By Dr. R. C. Sutcliffe. (Air Ministry: Meteorological Office.) (M.O. 432: A.P. 1699.) Pp. xiv+278+27 plates. (London: H.M. Stationery Office, 1939.) 7*s*. 6*d*. net.

THIS publication deals with those aspects of meteorology which are of importance in aviation; but as most of the subject-matter is the common ground of meteorology, the book will appeal to many who are not directly concerned with aviation. It is intended primarily to cover the meteorological syllabuses laid down for the various air navigators' and pilots' licences, and so supplies a long-felt want.

To some extent the information is presented in an encyclopædic, albeit very readable, form, and in this respect the volume recalls the very serviceable Admiralty Weather Manual. The statements that severe hail is "very rare" in the British Isles and that "for really spectacular hailstorms it is necessary to go to tropical and sub-tropical regions" perhaps call for some revision. Hail is a veritable scourge in many parts of central and southern Europe, and in France an elaborate organization for the defence of the vineyards has been in existence for several years (see *Geog. J.*, December 1939, p. 509). L. C. W. B.

PSYCHOLOGY

Psychological Foundations of Personality

A Guide for Students and Teachers. By Prof. Louis P. Thorpe. (McGraw-Hill Series in Education.) Pp. xvi+602. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 21*s*.

THE author is assistant professor of education in the University of Southern California. His book is one of many on personality and compares very favourably with most.

Prof. Thorpe has wisely left out the usual string of illustrative cases which contrive to spoil most books on the subject and are usually a complete waste of time to read. Most readers have ample clinical material of their own; to those who have not, cases usually add confusion and a certain superficiality.

After reading books on personality, the present reviewer always wonders, Is the world any better for all this? Time alone will show.

The Family meets the Depression

A Study of a Group of Highly Selected Families. By Prof. Winona L. Morgan. (Institute of Child Welfare, Monograph No. 19.). Pp. x+126. (Minneapolis: University of Minnesota Press; London: Oxford University Press, 1939.) 9*s*. net.

THIS is a study of the economic stability and psychological adjustments of several hundred families drawn from different parts of the United States. A prior study of the same families was carried out in 1927 and the present investigation was planned with the purpose of discovering any effects due to the intervening five-year period of economic depression (1927–1932). A comparison is made between the earlier and later results. The sample of families was relatively homogeneous as regards socio-economic status. The general outcome, according to the author, seems to favour the family as a social institution.

Biographies of Child Development

The Mental Growth Careers of Eighty-four Infants and Children; a Ten-Year Study from the Clinic of Child Development at Yale University. Part 1, by Dr. Arnold Gesell; Part 2, by Dr. Catherine S. Amatruda, Dr. Burton M. Castner, Dr. Helen Thompson. Pp. xvii+328. (London: Hamish Hamilton, Ltd., 1939.) 15*s*.

GESELL'S valuable contributions to the field of mental growth and developmental norms in infancy need no introduction. The present work by Gesell and three associates is the result of cumulative observations carried out over a period of ten years, on eighty-four infants and children. A wide diversity of cases, mostly typical and touching many aspects of child psychology, is to be found in this study. The primary aim of the authors is to assess the prognostic value of the normative criteria used at the Yale Clinic of Child Development. The book is carefully written and may be recommended to psychologists in Great Britain.

Psychopathic States

By Prof. D. K. Henderson. (Thomas W. Salmon Memorial Lectures.) Pp. 178. (London: Chapman and Hall, Ltd., 1939.) 8*s*. 6*d*. net.

THE Salmon Memorial Lectures for 1938 were delivered by Prof. D. K. Henderson of Edinburgh. They deal in a very fascinating manner with the problem presented by the psychopath and his many bizarre disorders of conduct.

It is difficult to make the lay mind understand that these mental disorders can occur and usually do occur in individuals who are of normal intelligence. They are disorders of conduct and as such are very difficult to deal with; further the law is frequently no help and the individual too cunning to help society, often his greatest enemy.

PHYSICS

Cosmic Rays and Mesotrons

By Dr. H. J. J. Braddick. (Cambridge Physical Tracts.) Pp. x+68. (Cambridge: At the University Press, 1939.) 5*s*. net.

In a subject that has been developing as rapidly as that of cosmic rays, the writing of books is a difficult and often not very fruitful task. Anything in the nature of a treatise is as yet impossible, and treatment of special branches may be out of date by the time a book can be prepared and published. But special circumstances have enabled the author of this work to avoid this pitfall. The small size of the Cambridge Physical Tracts, in this case only 65 pages, calls for extreme condensation, but makes possible rapid publication. Revision has been made to June 1939, so the book may be considered as up to date as is humanly possible. The author does not pretend to cover completely the whole subject. The first part is a useful digest of the more significant experimental results, while the second is a review, from the theoretical side, of the passage of cosmic rays through matter, and in particular of the shower phenomenon. One chapter is devoted to the mesotron, and contains the evidence for assuming the existence of a new particle of mass intermediate between the proton and the electron. There is also a short discussion of its theoretical implications.

A selected bibliography will enable the reader to pursue the subject more deeply.

Absolutkolorimetrie

Von Prof. Dr. A. Thiel. (Arbeitsmethoden der modernen Naturwissenschaften.) Pp. xv+215. (Berlin: Walter de Gruyter und Co., 1939.) 10.80 gold marks.

Prof. Thiel is to be congratulated on the clear and comprehensive account which he has given of his work on the application of colorimetry, which has enabled him to elaborate a technique whereby many inorganic and organic substances can be quantitatively determined optically with an accuracy not before achieved by this method of analysis.

The book is divided into two parts, in the first of which is explained the general principles of colorimetry, the technique used and the apparatus employed. The second section gives details of the practical application of Thiel's method of analysis for the quantitative determination of both inorganic substances and of many organic compounds which are of special interest to biologists and medical workers, notably the vitamins and hormones.

The book is a welcome addition to the essential text-books of chemical and biological laboratories.

A Text Book on Light

By Dr. A. W. Barton. Pp. x+426+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 8*s*.

There are several features of interest in this new book on light by the headmaster of King Edward VII School, Sheffield. The method of presentation is historical, but only "in the sense that the discovery of facts and the development of ideas is presented as they occur historically". There is an unusually good account of Newton's experiments and of his deductions from the facts of observation. It is then pointed out how the mass of evidence grows until one theory fails and another has to take its place. The author adopts the convention as to signs which counts distances measured from the pole of a refracting surface in the *same* direction as the initial direction of the light positive, and the diagrams in the book are drawn with the incident light travelling from left to right so as to give agreement with the usual convention of coordinate geometry. Special mention must be made of the beautiful photographs supplied for the plates by Mr. J. W. Cottingham of Barnsley Grammar School and Dr. J. W. Mitchell of Repton School.

A Text Book of Applied Hydraulics

By Prof. Herbert Addison. Second edition, revised and enlarged. Pp. xii+435. (London: Chapman and Hall, Ltd., 1938.) 21*s*. net.

The issue of a second edition of Prof. Addison's manual is evidence that it has served the purpose which he had in view in writing more especially for "those whose work is not directly connected with hydraulics, but who require to be kept in touch with the main outlines of hydraulic practice".

The new edition makes good a deficiency in the earlier issue in that it contains a useful bibliography of the works to which allusion is made in the text, and there is an additional chapter devoted to propeller and screw pumps. A commendable feature is the number of examples with solutions, numbering 125 and occupying 73 pages. These should be helpful to the teacher, as well as to the student reader who may be working without oral help.

The author is careful to point out that hydraulic formulæ, purporting to be based on identical data, can, and often do, yield different results. This warning is particularly necessary in the case of students and young engineers, who are apt to imagine that a formula is an infallible, as well as a labour-saving, device.

Theoretical Mechanics

A Vectorial Treatment. By Prof. Carl Jenness Coe. Pp. xiii+555. (New York: The Macmillan Company, 1938.) 21*s*. net.

In this book on theoretical mechanics, Prof. Coe, of the University of Michigan, has adopted from the outset the methods and notation of vector analysis, which provide a language common to all the branches of mathematical physics. His aim has been to present an introduction to classical mechanics, and through it to mathematical physics, which shall make clear the postulates on which they rest, and at the same time to explain and apply the basic principles of the vector method. He claims that this approach has proved its value in teaching and enables the student to use vector analysis in his later work. The book, which may be confidently recommended, contains sufficient material for an introductory and an advanced course.

TECHNOLOGY

Principles of Mechanism

By F. Dyson. Third edition. Pp. vii + 364. (London: Oxford University Press, 1939.) 12*s*. net.

FIRST published in 1928 and now already appearing in its third edition, this text-book has fully proved its adequacy for the purpose for which it was written. This was to present the fundamental principles which apply to the moving parts of machines in a sufficiently comprehensive manner to satisfy the requirements of those studying for the engineering degree or for the examinations of the engineering institutions. The line taken by the author was to develop the theory of machines in logical sequence from the well-known principles of mechanics, of which a summary was given in the first chapters. That the third edition exhibits no substantial change in the structure of the book, beyond a number of additions made necessary by the increasing scope of the examination syllabuses, is evidence of the sufficiency of this method of presentation.

The additions fall into two classes, the first of which includes a description, explanation and analysis of the pre-selective epicyclic gear-box. Such an example requires very careful treatment, as each operative gear is a combination of simple mechanisms, and here the method of analysis has been set out in full detail, thus giving the student a lead which should enable him to deal successfully with any other complication of epicyclic gears. The second class of additions comprises several of the more difficult examples of the determination of the acceleration of points in mechanisms. There is an acceleration diagram for a quick-return motion fully explained in the appendix, and as this case is more difficult than that of the simple link mechanisms, this constitutes a very welcome piece of extra information for the student. The exact mathematical analysis of the acceleration of a piston and that of a follower in contact with a cam face of straight or circular outline are also new. What the student will greatly value is the clear, direct, and unambiguous style in which the author expresses himself.

Colour Cinematography

By Major Adrian Bernard Klein. Second edition, revised and enlarged. Pp. xxii + 463 + 42 plates. (London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

IN the previous edition Major Klein gave us, in addition to much information and informed criticism on all aspects of motion pictures in colour, first-hand knowledge of the Gasparcolor system. He has since migrated to the Dufay-Chromex concern and now treats us with details of the Dufay system, the commercial difficulties, and the brilliant way in which they have been met. Perhaps we shall not get the full story of the most used colour process until he is acquired by Technicolor. The text remains a most useful historical summary of the subject, a guide to the present application of scientific principles in a difficult branch of commercial engineering, and a severe criticism of usage. Of particular mention are the Dufay printing and mitigation of moiré, the treatment of beam-splitter cameras, the development of suitable light-sources, and the calculation of filter transmissions. We wish other publishers would emulate the gay colours of the binding.

L. E. C. H.

Wissenschaftliche Photographie

Eine Einführung in Theorie und Praxis. Von Prof. Dr. E. v. Angerer. Zweite gänzlich neubearbeitete Auflage. Pp. vii + 211 + 3 plates. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 13.80 gold marks.

THIS volume is addressed to the scientific worker who uses photography as a tool rather than to the specialist in photographic technique or theory. Thus the book is written in a style easily understood by anyone with a rudimentary knowledge of physics and chemistry. It describes the nature of the photographic emulsion, its sensitometry and treatment after exposure in considerable detail. The production of the positive print, colour photography and the camera itself are only described to an extent sufficient to make the book complete. This is as it should be, for the main concern of such a book is to guide the experimenter to find the best possible conditions for obtaining the most satisfactory negative. It is, however, more than a photographic manual, for it contains much interesting information for the reader with only a casual acquaintance with photographic methods.

H. W. M.

The Art of Soaring Flight

By Wolf Hirth. Translated from the German by Naomi Heron Maxwell. Pp. 214. (London: *Sailplane and Glider*, 1938.) 5*s*.

AN English translation of the work of Wolf Hirth, one of the pioneers of soaring flight, was called for by reason of the rapid strides made in the art during recent years in Great Britain and America.

The translator says: "No student of soaring flight can ever hope to achieve success without an understanding of certain meteorological phenomena which are clearly explained in this book, and I feel that the reader will find every page both stimulating and interesting". There are accounts of storm-flying and interesting information on the obstruction of fronts by mountain ranges and the like. Sailing in the air, to a greater extent even than on water, raises a host of meteorological questions which would otherwise never be thought of.

L. C. W. B.

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to secure co-ordination between the scientific departments of the fighting Services and the Ministry of Supply, and the extent of the co-operation between the British and French Governments in these matters. Lord Strabolgi said he did not wish his remarks to be interpreted as hostile to the Government, and he paid tribute to the strength of the recently appointed Advisory Council of Scientific Research and Technical Development. The reply elicited from Lord Chatfield, Minister for the Co-ordination of Defence, was informative and important as indicating the extent to which the knowledge and services of men of science are being utilized.

Lord Chatfield paid a tribute to the value of scientific research to the Services. The existing establishments were in the main created after the War of 1914–18 or during its later years. They now include many of the leading men of science in the country, either in a working or advisory capacity. He referred to eight research laboratories under the Department of Scientific and Industrial Research, and said: "Generally it is perfectly correct to say that the scientific talent of this country is fully mobilized to its fullest advantage and runs into a very large number of scientists, to be numbered rather in thousands than in hundreds." There is no central organization for dealing with inventions, which actually constitute only a small part of the scientific work in progress. Each Service department and the Air Raids Department of the Ministry of Home Security has its own organization for dealing with inventions, and there is constant consultation between these bodies.

Dealing with the exchange of scientific knowledge between the British and French Governments, Lord Chatfield said that co-operation had begun before the outbreak of war, and that there is now "complete exchange of scientific information". Members of the scientific organizations of the two countries are working in each other's establishments. Further efforts are being made, however, to extend the present liaison. Steps are under consideration to safeguard the interest of inventors, and it is likely that machinery similar to that used during the War of 1914–18, namely, a Commission of Awards to Inventors, would be adopted.

Science and War

PROTECTION of civilian population from attack by deadly weapons that science has created is set forth as one of the paramount duties of science in the present emergency, in the annual report by Dr. Vannevar Bush, president of the Carnegie Institution of Washington, recently issued. The same science which saves life and renders it rich and full, also destroys it and renders it horrible. Is it then possible to remain in a detached atmosphere to cultivate the slowly growing body of pure scientific knowledge, and to labour apart from the intense struggle in which the direct application of science now implies so much for good or ill? As science has produced a weapon, so also can it produce in time a defence against it. Science is dedicated to the advance of knowledge for the benefit of man. Here is a sphere where the benefit might perhaps indeed be immediate, real and satisfying. Can a scientific worker, skilled in a field such that his efforts might readily be directed to the attainment of applications which would afford protection to his fellow-men against such an overwhelming peril, now justify expending his effort for any other and more remote cause?

Although immediate participation of the men of science in the safeguarding of civilization is urged by Dr. Bush, he gives the warning that we should not become stampeded. "There is still a duty to keep the torch of pure science lit, and this duty is only the greater under stress. All the long struggle of a harsh evolution, the pitting of species against the environment, has produced a being whose primary distinction is conscious cerebration, and whose crowning attribute is his intellectual curiosity concerning his complex environment and a thirst for knowledge transcending the mere struggle for existence. If there is no abiding value in a Beethoven symphony, or a theory of the cosmos, or the tracing of an ancient culture, then the Carnegie Institution of Washington has scant reason for existence. If it is really good that man should look at the stars and should contemplate his great destiny, then it is imperative that in those regions which enjoy the blessings of peace the search for the eternal verities should continue."

Recent Earthquakes

AFTERSHOCKS of the earthquake of December 26 in Turkey continue to be felt in widely separated areas. The epicentres are by no means confined to the Erzinjan-Erbaa area, thus lending support to the original estimate from Istanbul of a depth of focus of the original earthquake of the order of sixteen miles. On January 17 eight rather violent tremors were felt in the original area and other violent tremors were experienced at Istanbul, Smyrna, Castamouni, and Izmid. A *Times* report states that at the last-named place an entire hill slid downwards, blocking the road to Kandira. No further casualties are reported from these areas. On January 16 an earthquake occurred at the village of Balcikoy near Nigde, causing two hundred houses to collapse, killing five people and injuring sixteen. The death roll was small because a light foreshock preceded the principal shock, causing people to run out of doors. On January 17 at night, two more violent earthquakes were felt at Nigde, which is in southern Anatolia. These caused four hundred houses to collapse, killing fifty people and injuring a hundred and sixty others. A. Hée of the central seismological bureau, now at Clermont-Ferrand (France), has taken the readings of fifteen observatories and determined the epicentre of the original shock to have been near latitude 39·5° N., longitude 38·2° E.; initial time 26d. 23h. 57m. 23s. G.M.T.

An earthquake of intensity VII, and approaching intensity VIII on the modified Mercalli scale of 1931, was felt in Palermo at 2.18 p.m. (local time) on January 15. Much damage is reported to have been caused to the façade of the monumental church of St. Anna, one of the oldest in Sicily; some damage has been done to the Cathedral, and cracks have appeared in many walls of the poorer type of building. Two people have been killed by falling masonry and twenty-five injured. The electricity supply was temporarily out of action. The earthquake was the most severe for many years, and alarm was caused especially amongst children and people in the poorer quarters of the city. According to a *Times* message, the epicentre of the shock is estimated to have been between Palermo and the islands of Ustica and Alicudi to the north-north-west of Palermo, which would be approximately 38·5° N., 13·25° E. This is in a relatively highly active region seismically, and earthquakes occurred near to this epicentre on August 17, 1926 (38·5° N., 15° E.) and August 21, 1930 (39° N., 14·5° E.). The great Messina earthquake of December 28, 1908, which has been described by Davison, affected this area, according to Baratta, though the epicentre was, of course, somewhat to the east of the present one.

From 1.30 a.m. on January 17, and continuing for three hours at intervals, Paris experienced earth tremors so slight that they were not felt by anyone. The tremors were recorded on the seismographs at the Paris Observatory.

Native Races and Tuberculosis

SOME interesting data bearing upon recent theory of the racial incidence of disease are brought together and discussed in relation to tuberculosis in the *Lancet* of January 13. The older view ascribed the apparently selective action of the infection on native races mainly to innate biological differences, but there is now a tendency to emphasize work and living conditions—with the consequent risk of intense exposure and deficient resistance—on one hand, and the factor of bacteriological immunity on the other. Thus a recent view is quoted in which there is represented a balance between heredity and environment. The emphasis now being laid on social factors, it is suggested, opposes the defeatist attitude that native races are just 'different', and indicates lines of action within human control.

In support of this view, attention is directed to the situation at present in India and Africa. On the Rand, although the incidence among natives working in the mines has fallen considerably in recent years, the incidence among natives in the Union has probably fallen little, if at all. All cases discovered in the mines are repatriated at once and the majority are dead in two years. Thus there is a continuous stream of infectious men returning to the territories from which are derived a return stream of new recruits. There are no sanatoria and little provision of public medical service. In India, a similar situation has arisen in the interchange between urban and rural areas which the growth of industrialism and transport facilities has made possible, with the result that Bengal alone is said to have a million cases of tuberculosis and a hundred thousand deaths annually.

Analysis of the data of the incidence of tuberculosis among non-European or primitives would seem to justify the contention that the problem is now most serious where native agricultural populations are becoming industrialized. That the situation is remediable is indicated by the situation under the Russian Soviets, where rapid industrialization has been accompanied by expansion of the tuberculosis services, with the result that there has been a notable decline in tuberculosis mortality. The writer in the *Lancet* concludes with the admonition that it is the white man's responsibility that the situation in the British Empire should be squarely faced.

Mental Disease in Peru

IN a recent paper (*Amer. J. Psychiat.*, **96**, 403; 1939) Dr. Horatio M. Pollock states that the care of the mentally sick in Peru has gone through a series of progressive stages similar to that in the development of psychiatric science in the United States. A long period of neglect was succeeded by one of inadequate care in almshouses or asylums, which in turn was followed by so-called hospital care with some degree of medical attention, and finally scientific treatment in a modern hospital. The first hospital treatment for mental patients in Peru was provided in the seventeenth century in two general hospitals at Lima, one being St. Andrew's Hospital for men and the other the St. Anne's Hospital for women. Towards the middle of the nineteenth century the special section in the St. Andrew's Hospital became an independent unit with a special physician to look after the patients, and in 1859 a new building named "Hospital de la Misericordia" for mental patients was opened in the outskirts of Lima with accommodation for 160 patients. It was divided into four sections, respectively for quiet cases, those periodically disturbed, mental defectives and epileptics, and violent cases.

In 1918 an entirely new hospital for mental patients, which was named after its benefactor Victor Larco Herrera, was opened at Magdalena del Mare about four miles from Lima with accommodation for more than a thousand patients. The treatment in this hospital has been modernized, and at the present time compares favourably, according to Dr. Pollock, with that in many hospitals in the United States. A single hospital, however, is not sufficient for all the persons requiring mental treatment in Peru. At least two more are needed, and funds are not yet available for enlargement of the present building.

Higher Education in Malaya

"HIGHER EDUCATION IN MALAYA" (H.M. Stationery Office, 2*s*. 6*d*.) is a thorough and most valuable survey. It includes the whole background of teaching and adds an able summary of the resources of the country, mainly due to the rubber plant, and the variety of its population, Chinese, Indians and Malays. The last-named have only been under Western civilization for 60–70 years. They do not dwell in towns like the Chinese. Raffles College, opened in 1928, is the main centre of advanced education, and is increasingly appreciated by parents, who recognize the value of its teaching. One of the difficulties is that English is learnt as a foreign language; so that subject can scarcely be taken, as at the University of London, with Middle English and Anglo-Saxon as necessary adjuncts. It would be like studying Latin in early and medieval sources as well as Virgil and Cicero. The Commissioners urge that the standard of the London degree should be attempted and some modification of the English course allowed, tending to special knowledge of English masterpieces.

The present diploma of the College is not recognized outside Malaya, and not much progress can be achieved without some external assistance in the examinations, which could be managed by the use of air-mail. The professors take leave once in three years, which puts rather a heavy burden on their substitutes, but gives them a chance to meet external examiners. The present arrangements for a president are inadequate, and the "high wastage rate" of failures needs to be reduced. Several drastic improvements are suggested. We regret to notice that science teaching in the schools is generally in a very backward state, and biology has been scarcely begun. The King Edward VII College of Medicine at Singapore is well equipped and does good work within its limits; but it needs a larger scope, particularly regarding public health.

International Journal of Agrarian Affairs

THE first International Conference of Agricultural Economists was held ten years ago. As the period elapsing between meetings is now three years, some means of maintaining an interchange of ideas, beyond the issue of the proceedings, seemed desirable. The *International Journal of Agrarian Affairs*, the first number of which has just been published, is a bold attempt to meet this need. Two numbers will be brought out each year, the intention being to develop a series of studies on economic and social problems, one such problem being dealt with at a time. The *Journal* will therefore serve as a complement rather than an addition to the statistical year-books of agricultural information which are already available. The kind of topics which will form the subject-matter are those common to all countries, and the aim will be to emphasize the universal concern with the solution of such problems, and to discuss them from all possible angles.

The first number deals with the problem of surplus agricultural population. Contributions are made from such widely different localities as Harvard University, Edinburgh, Washington, Quebec, Sofia and Riga. The theoretical basis of the problem is first discussed and an account given of the historical influence of landowning. Other writers stress the effect of policies of restriction on trade and on movements of population between countries, and describe the special problems of Bulgaria and Latvia, while as regards remedies the development of subsistence holdings is advocated. Though not actually the official organ of the International Conference of Agricultural Economists, the *Journal* will be issued free to all members. For non-members the price is 3*s.* 6*d.*, or £1 per volume of six numbers (including postage). All subscriptions and communications should be addressed to the Editor, 3 Magpie Lane, Oxford.

Meteorology in Iraq

THE third annual report of the Director of the Meteorological Service of the Government of Iraq, which covers the year ending March 31, 1939, shows that, owing to the difficulty of obtaining the necessary staff, the basic organization of the Service had not been completed by that date. For example, although new offices were available at Nasiriya and Diwaniya, no staff was available to man them. At the headquarters station at Baghdad, continuous records of wind, temperature, humidity and rainfall were maintained and were analysed and published in the Monthly Weather Report. Upper winds were measured three times a day, and the results appeared in the I.C.A.N. summaries published by the Meteorological Office, London, up to December 1938. After that month they were published in Iraq together with similar summaries obtained from stations maintained by the Air Ministry, Meteorological Service, Habbaniya.

Meteorological information continued to be supplied to civil aviation from Baghdad and Basra, the number of messages rising to 1,200 per month during the winter. As the volume of air traffic over Iraq continued to increase, difficulty was experienced in maintaining this part of the service, and the need for an extension of the existing wireless service was felt. As was only to be expected, the report contains little of purely scientific interest. Owing to the fact that air-conditioning engineers were constantly asking for data concerning the dust content of the air, the Director placed an order for an Owens settlement dust counter and for the necessary microscope for measuring the records.

Lantern Slides

THE cost of making lantern slides from illustrations may be materially reduced by using paper negatives, and Mr. G. H. Bell, of the Physiological Institute, Glasgow, gives an account in the December issue of the *Journal of Scientific Instruments* of a method he has found very satisfactory. He uses "Kodaline Paper Slow" exposed for three minutes at *f*/11, the illustration being illuminated by four 100-watt lamps placed just behind the camera lens. He develops with Kodaline developer and gets a pure black and white negative. He prints on gas-light lantern plates using a mask and giving an exposure of 8 seconds for a surface intensity of 65 foot-candles, uses an energetic developer and gets a slide with black lines on a perfectly clear background both for line diagrams and half-tone illustrations.

Drift of the *Sedov*

THE Northern Sea Route Administration of the U.S.S.R. is preparing for press a collection of articles and other material relating to the remarkable drift of the icebreaker *Sedov* in the Arctic, the crew of which was reported to have been taken off the icebound vessel by the icebreaker *Joseph Stalin* on January 13. The *Sedov* commenced her drift on October 23, 1937. The book being prepared for press tells the story of the *Sedov's* unprecedented drift. It contains articles by I. D. Papanin, head of the Northern Sea Route Administration and leader of the North Polar Expedition on the drifting icefloe of 1937–38, and by Prof. N. N. Zubov, and diaries of members of the *Sedov's* crew.

Clough Memorial Research Fund

The Clough Memorial Research Fund of the Edinburgh Geological Society was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England; the north of England is defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Under the terms of administration of the Fund, a sum of approximately £30 is available annually. Applications for grants are invited for the period April 1, 1939, to March 31, 1940. These applications should state the nature of the research to be undertaken and the amount of grant desired. Applications must be in the hands of the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than March 1.

Royal College of Physicians: Lectures

The following lectures have been arranged by the Royal College of Physicians to be delivered at the College, Pall Mall East, London, at 2.30 p.m.: Mitchell Lecture (postponed from 1939), Dr. F. G. Chandler, "Some Observations on the Diagnosis and Treatment of Pulmonary Tuberculosis" (February 7); Milroy Lectures, Dr. R. E. Smith, "Acute Infectious Diseases at School" (February 13 and 15); Goulstonian Lectures, Dr. W. D. W. Brooks, "The Pathology and Treatment of Pulmonary Tuberculosis" (February 22, 27 and 29); Bradshaw Lecture (postponed from 1939), Dr. J. C. Spence, "On the Nature of Disease in Infancy" (March 7); Oliver-Sharpey Lectures, Prof. E. P. Cathcart, "The Mystery of Alimentation" (March 12 and 14); Croonian Lectures, Dr. George Graham, "Recent Advances in Diabetes Mellitus: Aetiology and Treatment" (May 16 and 21).

Royal Aeronautical Society: Lectures

Arrangements are being made by the Royal Aeronautical Society to resume part of the lecture programme which was postponed on the outbreak of war. It is hoped to arrange definitely for four or five lectures. The first one, on aircraft production, will be given by Mr. H. J. Pollard, on March 12 at 6.0 p.m., in the Institution of Electrical Engineers. Sir Alan Cobham and Mr. Marcus Langley have provisionally agreed to give a joint lecture on flight refuelling in the air; Mr. A. A. Hall on recent theoretical and experimental work on turbulence; Wing Commander T. R. Cave-Brown-Cave on noise and nuisance in aircraft, at dates to be fixed. The Wilbur Wright Lecture will be delivered at the end of May.

The Night Sky in February

During this month, the night shortens in the latitude of London by 1¾ hours. The moon is new on February 8 and full on February 23. Lunar conjunctions with the planets occur as follows with Venus on February 11d. 21h., with Jupiter on 12d. 14h., with Saturn on 14d. 3h., with Mars on 14d. 4h. It will be seen from these conjunctions that the bright planets are a striking feature in the evening skies, enhanced by the presence of the crescent moon. On February 13 at 8h., Mars which had overtaken Jupiter on January 7, is in conjunction with Saturn, while on February 20 at 22h., Venus and Jupiter are in conjunction. On February 28, Mercury is at greatest elongation (18° east) and should be visible low in the west after sunset, leading the train of five bright planets in addition to Uranus (stellar magnitude 6) in the constellation Aries. The planet Neptune, which transits about 2h. in mid-February, approaches the 8th magnitude star, B.D. + 3° 2549 (Lalande 22237) on February 14. The light variation of Algol (total variation mag. 2·2–mag. 3·5) is best seen about 1½ hours before and after the following epochs: February 8d. 4·5h., 11d. 1·3h., 13d. 22·1h. and 16d. 19·0h.

Announcements

Prof. Max Borst, professor of morbid anatomy at Munich, has been awarded the Goethe Medal for art and science on the occasion of his seventieth birthday for his work on cancer.

Sir Humphry Rolleston, chairman of the executive committee of the Imperial Cancer Research Fund since 1924, and Sir Thomas Dunhill, sergeant-surgeon to the King, were admitted to the honorary fellowship of the Royal College of Surgeons of England at a meeting of the Council on January 11. Sir Hugh Devine, president of the Royal Australasian College of Surgeons, has accepted the honorary fellowship subject to the condition of personal attendance at the College at some future date.

The number of births in France, which was 1,022,000 in 1876, fell to 750,000 in 1930 and 616,000 in 1939. For the last three years the number of deaths has exceeded the number of births by 14,000 annually.

Dr. Frans Verdoorn, formerly of Leyden, Holland, has now gone to the United States. Dr. Verdoorn controls the following publications: *Chronica Botanica*, New Series of Plant Science Books, "World List of Plant Science Institutions", "International Address Book of Plant Taxonomists", *Annales Bryologici* and other bryological publications. All communications concerning these should now be addressed to Dr. Frans Verdoorn, Chronica Botanica Co., c/o the Arnold Arboretum, Jamaica Plain, Mass., U.S.A.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

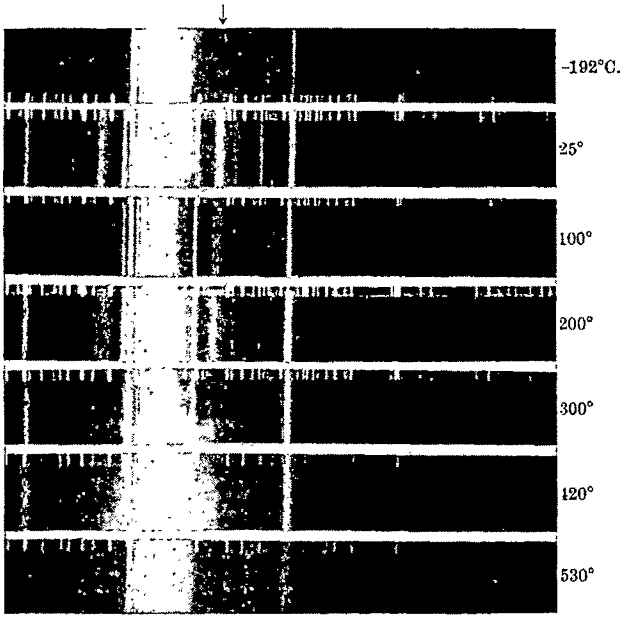
Notes on points in some of this week's letters appear on p. 151. Correspondents are invited to attach similar summaries to their communications.

The α-β Transformation of Quartz

As is well known, the ordinary form of quartz which has trigonal symmetry changes over reversibly to another form which has hexagonal symmetry at a temperature of 575° C. Though the transformation does not involve any radical reorganization of the internal architecture[1] of the crystal and takes place at a sharply defined temperature, it is nevertheless preceded over a considerable range of temperature (200°–575°) by a progressive change in the physical properties of 'low' quartz which prepares the way for a further sudden change, when the transition to 'high' quartz actually takes place. The thermal expansion coefficients, for example, gradually increase over this range of temperature, becoming practically infinite at the transition point and then suddenly dropping to small negative values[2]. Young's moduli in the same temperature range fall to rather low values at the transition point and then rise sharply to high figures[3]. The piezo-electric activity also undergoes notable changes[4,5].

In the hope of obtaining an insight into these remarkable phenomena, a careful study has been made of the spectrum of monochromatic light scattered in a quartz crystal at a series of temperatures ranging from that of liquid air to nearly the transition point. Significant changes are observed which are illustrated in the accompanying illustration, reproducing part of the spectrum excited by the 4358 A. radiation of the mercury arc. A fully exposed spectrum at room temperature indicates fourteen different normal modes of vibration of the crystal. At liquid air temperature, the three most intense lines correspond to the frequency shifts 132, 220 and 468 cm.$^{-1}$ and are all about equally sharp. As the crystal is heated over the temperature range 200°–530°, notable changes occur. The 220 cm.$^{-1}$ line (marked with an arrow in the reproduction) behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced.

The behaviour of the 220 cm.$^{-1}$ line clearly indicates that the binding forces which determine the frequency of the corresponding mode of vibration of the crystal lattices diminish rapidly with rising temperature. It appears therefore reasonable to infer that the increasing excitation of this particular mode of vibration with rising temperature and the deformations of the atomic arrangement resulting therefrom are in a special measure responsible for the remarkable changes in the properties of the crystal already mentioned, as well as for inducing the transformation from the α to the β form.



Light scattering in quartz.

C. V. Raman.
T. M. K. Nedungadi.

Department of Physics,
Indian Institute of Science,
Bangalore.

Dec. 11.

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[1] Bragg and Gibbs, *Proc. Roy. Soc.*, A, **109**, 405 (1925).

[2] Jay, *Proc. Roy. Soc.*, A, **142**, 237 (1933).

[3] Perrier and Mandrot, *C.R.*, **175**, 622 (1922).

[4] Osterberg and Cookson, *J. Frank. Inst.*, **220**, 361 (1935).

[5] Pitt and Mckinley, *Canad. J. Res.*, A, **14**, 58 (1936).

First Benedicks Effect in Gas-free Mercury, as Influenced by the Mean Temperature

IN a previous letter[1] we have shown that, in mercury carefully freed from gas ions, the First Benedicks effect exists with a positive sign, whereas in the presence of gas ions the effect had shown a negative sign. The influence of gas ions actually seems thoroughly to modify the thermo-electric properties of some metals.

In view of the fundamental character of this influence, the experiments on mercury have now been repeated, using a strangulation apparatus made of silica, with a new heating arrangement (hot and cold flowing oil), and also a photographic registration method. Fig. 1 exemplifies the registrations finally obtained: in the upper parts are to be seen the relay-amplified deflections of the galvanometer, showing small oscillations due to Brownian movement; below, the corresponding temperature registrations.

The new observations were found entirely to confirm the positive character of the effect in gas-free mercury. They further reveal a new, important fact.

From a quantitative point of view, the effect is determined by the formula

$$u = K \cdot \frac{3}{\Delta t} \qquad (1)$$

The parameter K, depending on the metal and, to a certain extent, on the apparatus used (here No. 20), and hence now designated as K_{20}, has been calculated from the observations, using (1), and plotted as ordinates in Fig. 2, where abscissæ are the mean temperatures t_{med}.

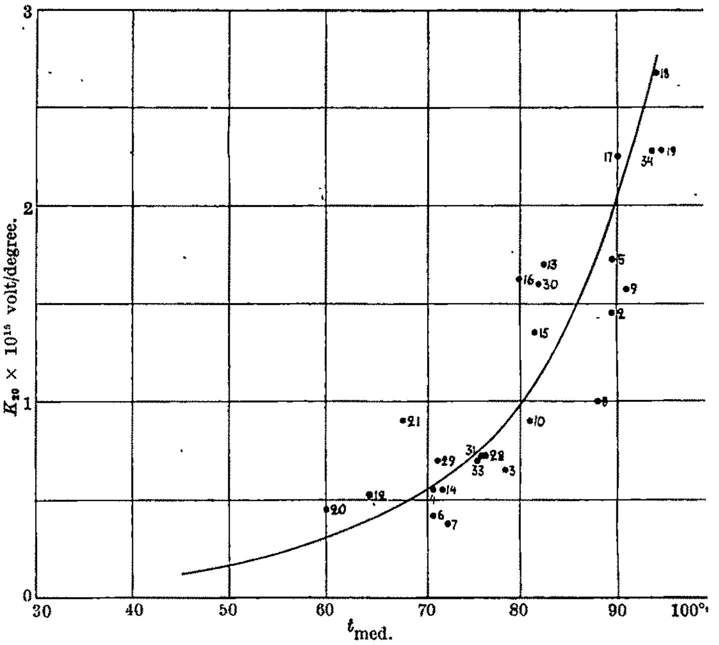

Fig. 2.

FIRST BENEDICKS EFFECT IN MERCURY.

It will be seen that the effect varies with the temperature, *increasing in a strongly accelerated way*.

It is interesting that this increase, with increasing temperature, of the First Benedicks effect appears to be just the same as that which has been discovered earlier for the reversed effect, the Second Benedicks effect[2], and which presents a striking similarity to the well-known Richardson formula, valid for electron emission from glowing metals. It actually appears plausible that the emission of electrons along a steep temperature gradient in the metal may follow the same law as the emission into vacuum.

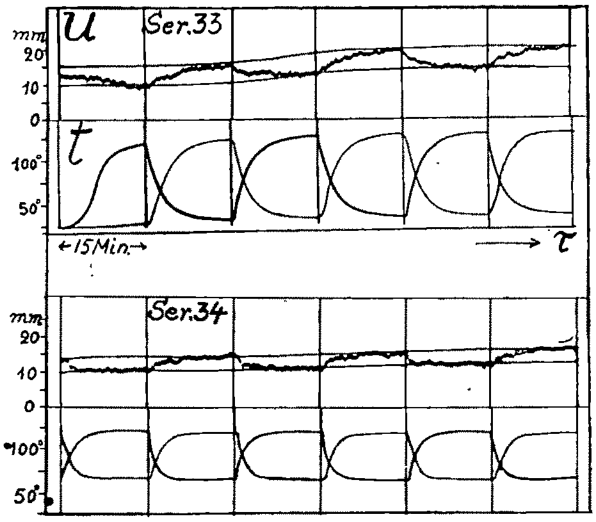

Fig. 1.

C. BENEDICKS.
P. SEDERHOLM.

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Stockholm.

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[1] NATURE, 141, 1097 (1938).

[2] Benedicks, C., and Siljeholm, G., *Ark. Mat. Astron. Fys., Stockholm*, 24 A, No. 7 (1933), (see Fig. 41).

Magnetic Anisotropy of Diphenyldiacetylene

E. H. WIEBENGA has recently determined the crystal structure of diphenyldiacetylene[1] $(C_6H_5).C{:}C.C{:}C.(C_6H_5)$. The molecule is plane, with a straight carbon chain, the length of the molecule making angles of approximately 48°, 52°, 78° with the *a,b,c* axes of the monoclinic unit cell. (By inadvertence, the complements of the first two angles were given in Dr. Wiebenga's letter in NATURE. He has since very kindly sent me the exact direction cosines determined by means of a Fourier analysis and has also provided me with some beautiful crystals for this investigation.)

The magnetic anisotropy of the crystals, weighing about 4 mgm. each, density 1·170 gm./c.c. at 20° C., was determined by Krishnan's second method in a field of some 7,000 oersted. The minimum diamagnetic susceptibility was determined by the flotation method. The principal crystal susceptibilities are $\chi_1 = -93{\cdot}8 \times 10^{-6} (\pm 0{\cdot}5)$, $\chi_2 = -188{\cdot}0 \times 10^{-6}$, $\chi_3 = -109{\cdot}6 \times 10^{-6}$, $\psi = -88{\cdot}5°$. Hence the mean susceptibility is $-130 \cdot 5 \times 10^{-6}$, as compared with $-115 \cdot 9$ for tolane and $-102 \cdot 9$ for diphenyl. Pascal's rules would give $\chi = -129 \cdot 7$ for diphenyldiacetylene: he himself found the value $-129 \cdot 3$ (corr.). The principal susceptibilities of a single molecule, deduced from the above data and the molecular direction cosines, are $K_L = -109 \cdot 4$, $K_M = -75 \cdot 3$, $K_N = -206 \cdot 7 \times 10^{-6}$.

Comparing these with the corresponding values for tolane[2], $K_L = -81 \cdot 5$, $K_M = -67 \cdot 8$, $K_N = -198 \cdot 5 \times 10^{-6}$, it will be seen that there is an abnormal increase of susceptibility along the carbon chain axis, indicating a concentration of electron density normal to that axis. This is in sharp contrast to the behaviour of chains of conjugated double bonds, for which the increase of susceptibility is always normal to the plane of the molecule, indicating a concentration of electron density in that plane. An exact Fourier analysis of the structure of diphenyl is very desirable, in order to extend the comparison from tolane to diphenyl.

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Jan. 9.

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[1] Wiebenga, E. H., NATURE, 143, 980 (1939).

[2] Lonsdale, K., *Proc. Roy. Soc.*, A, 171, 564 (1939).

Crystal Structure of Phosphorus Pentachloride

ALTHOUGH much work has been done on the molecular structure of phosphorus pentachloride, no crystal structure determination of this important substance has previously been made, presumably owing to experimental difficulties. In our separate laboratories, independent X-ray diffraction experiments have given the following results: Crystal system tetragonal, approximate cell dimensions $a_0 = 9 \cdot 2$, $c_0 = 7 \cdot 4$ A., density *circa* 2·0 gm./c.c., 4 molecules per unit cell, space group $P4/n$.

This information is sufficient to determine the constitution of the compound. Consideration of the space group symmetry and the available space shows that it is impossible to form a structure containing PCl_5 molecules of any configuration. For similar reasons the constitution $[PCl_4]^+Cl^-$ may also be rejected. An ionic structure containing tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$ groups completely satisfies the requirements. For a unit cell with origin as in the "Internationale Tabellen zur Bestimmung von Kristallstrukturen", the centres of $[PCl_4]$ groups are at 000, $\frac{1}{2}\frac{1}{2}0$, and those of $[PCl_6]$ at $0\frac{1}{2}z$, $\frac{1}{2}0z$, $z \approx \frac{5}{8}$. Preliminary Fourier analyses have confirmed these conclusions, and further details of the structure will be given later.

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D. CLARK.

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A. F. WELLS.

Crystallographic Laboratory,
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Dec. 23.

Degeneracy and Dissociation Constants

THE importance of degeneracy in enhancing the stability of radicals such as triphenylmethyl has been emphasized by many authors; for example, Pauling and Wheland[1], Ingold[2], etc. This being so, it is strange that no relations have been suggested between complexity of degeneracy (which we may define in terms of the number of possible resonating structures) and dissociation constants of series of related acids and bases. It is probable that simple relations will be discovered only in series where the inductive effects of substituent groups are negligible, or can be eliminated.

Consider the series of acids, methyl alcohol (K of the order 10^{-16}), acetic acid ($K = 1 \cdot 75 \times 10^{-5}$), phenylacetic acid ($K = 4 \cdot 88 \times 10^{-5}$), and diphenylacetic acid ($K = 11 \cdot 5 \times 10^{-5}$). (All K values, which are thermodynamic ones, have been taken from Dippy's recent article[3].) Now the inductive effect of the $C{=}O$ group moment fails to account for the enormous increase in strength (the ratio being 10^9) when we proceed from methyl alcohol to acetic acid, for chloracetic acid is only 100 times as strong as acetic acid. However, two resonating structures ($n = 2$) are possible for the acetic acid molecule ion, and the energy of resonance effects stabilization.

In the same way, the inductive effect of the phenyl group, which must be very small, will not account quantitatively for the acid strengths of phenylacetic and diphenylacetic acids. Even if we assumed (wrongly) that the increase in K in going from acetic to phenylacetic acid is due to an electrical inductive effect of the phenyl group generally designated as $-I$, the strength of diphenylacetic acid is definitely larger than what we should deduce on that hypothesis. It seems fairly obvious that the enhanced stability of the phenylacetic and diphenylacetic acid ions is due to an increase in the number of resonance

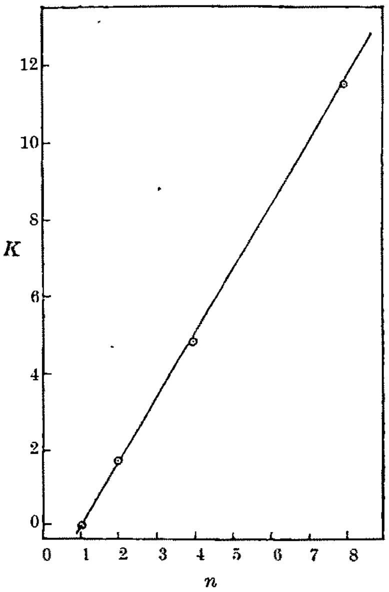

Fig. 1

possibilities, for it is easy to show that $n = 4$ and $n = 8$ respectively, and a linear relation (see Fig. 1) exists between K and n for the three acids. A fourth point for the line is provided if we assume that a non-resonating 'acetic acid' ($n = 1$) would have a strength of about 10^{-13} or zero on our scale. (Dippy and Lewis[4] have already identified the apparent intrinsic attraction for electrons exhibited by the phenyl group with its unsaturated character.) The dissociation constant of triphenylacetic acid in water has not been measured on account of solubility difficulties. Its strength may be predicted by extrapolation to $n = 16$ as $K = 25 \times 10^{-6}$.

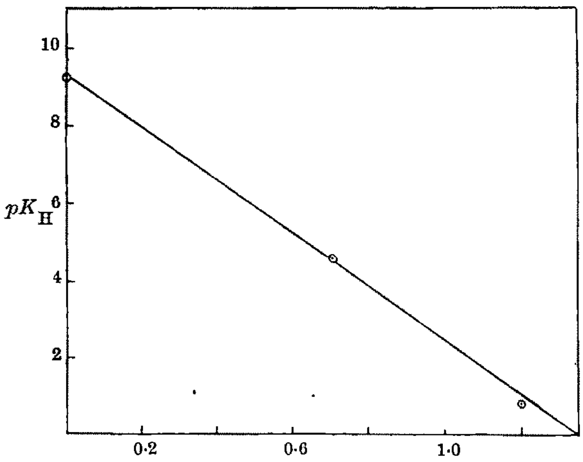

Fig. 2

In the case of a series of related bases, ammonia ($pK_H = 9{\cdot}27$, $n = 1$), aniline ($pK_H = 4{\cdot}62$, $n = 5$), diphenylamine ($pK_H = 0{\cdot}85$, $n = 16$), and triphenylamine ($pK_H = 0$, $n \gg 30$), it is the unionized molecule which is preferentially stabilized by the resonance energy. (Unlike the ion, the unionized molecule has a lone pair of electrons.) In Fig. 2 a plot is shown of pK_H against log n, and again a linear relation is found. This method of plotting is more convenient on account of the large difference in basicities. Triphenylamine has zero pK_H as predicted by the relation.

These methods of plotting are really equivalent to plotting the dissociation constant against the total resonance energy involved as n is increased. Each additional structure contributes equally to the actual hybrid state of the molecule. An examination of the dissociation constants of related series of compounds (and activation energies when reacting) will probably yield just as much valuable information about the relative importance of structures as heat data, internuclear distances, and electric dipole moments have already done.

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Dec. 6.

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[1] *J. Chem. Physics*, **1**, 362 (1933).
[2] *Trans. Farad. Soc.*, **30**, 52 (1934).
[3] *Chem. Reviews*, **25**, 151 (1939).
[4] *J. Chem. Soc.*, 1008 (1937).

Predaceous Phycomycetes from Cotswold Leaf-Mould

DRECHSLER[1] has described in America more than a dozen species of Phycomycetes parasitic on nematodes and terricolous amœbæ. These he places in the Zoopagaceæ, a family of uncertain taxonomy, related to the Mucorales. To the best of my belief, no members of this family have been recorded in Europe, with the possible exception of some organisms described by Penard[2] in 1913, and placed by him, probably incorrectly, in the Saprolegniaceæ. It may be of interest, therefore, to record the finding of four species of Zoopagaceæ in plate cultures inoculated with leaf-mould from wooded areas in the Cotswolds.

Cochlonema verrucosum, Drechsl., is endoparasitic in soil amœbæ. Infection begins by a conidium becoming attached to the pellicle of an amœba, and sending out a germ tube which enters the host and forms a mycelium within the endoplasm. This mycelium is thalloid, at first sub-spherical, becoming sausage-shaped, and finally twisted in a close spiral, usually of about one and a half turns. The diameter of a mature hypa is about 6 μ. Growth takes place at the expense of the host's protoplasm; but the host remains active until the parasite reaches an advanced stage. Multiple infection is usual. Finally, the host becomes immobilized and dies. Reproduction then occurs by means of chains of aerial conidia, borne on conidiophores usually 1·5 μ in diameter. The conidia are fusiform, 7 μ long and 1·5 μ in greatest diameter.

Sexual reproduction takes place by the union outside the host of slightly unequal gametangia. Zygospores are usually formed between gametangia from different mycelia; they are 10 μ in diameter and are enclosed in a thick wall, bearing on its outer surface twenty or more bullate protuberances.

Cochlonema dolichosporium, Drechsl., resembles *C. verrucosum* in size and habit, and was found attacking *Amœba similis*, Greef. It is characterized by its chains of elongate conidia, which have an average length of 20 μ and greatest diameter 1·5 μ. Like the conidia of *C. verrucosum*, their external wall is considerably sculptured. Zygospores of this species were not observed.

Stylopage haplœ, Drechsl., forms a sparsely branching mycelium, the branching being roughly at right angles. The hyphæ are non-septate, 1·2 μ–1·5 μ in diameter, and the cytoplasm is considerably vacuolated. Amœbæ become attached to the hyphæ, which send out dichotomously branching haustoria into the endoplasm of the host; the host eventually becomes completely absorbed, leaving only the shrivelled pellicle attached to the haustorium. Reproduction is by clavate conidia, 15 μ long and 2 μ–2·2 μ wide at the broadest part, borne singly on erect conidiophores 20 μ–30 μ long. Zygospores were not observed.

Stylopage hadra, Drechsl., resembles *S. haplœ* in habit, but is much larger, the rather straight, non-septate hyphæ measuring 4 μ–5 μ in diameter. This species catches nematodes, which become attached to the hyphæ, probably by means of some sticky substance. A bulbous lateral protuberance is formed on the hypha at the point of attachment of the nematode, and, from this, hyphæ grow out and ramify inside the host, absorbing its contents. Ultimately, only the withered integument of the nematode is left, attached to the bulb. Reproduction is by ovoid conidia, 25 μ–35 μ long and 15 μ–20 μ in greatest diameter, formed terminally on aerial conidiophores which may, by repeated growth, bear several conidia. Zygospores were not observed.

Further details of these and other related fungi will be the subject of a paper to be published later.

I should like to express my thanks to Dr. B. Barnes for much valuable advice and help, and also to Dr. C. G. C. Chesters, of the University of Birmingham, for kindly allowing me to use his laboratory.

C. L. Duddington.

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Chelsea Polytechnic,
London, S.W.3.
Jan. 4.

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[1] Drechsler, C., *Mycologia* **27**, 6-40; 176-203; 206-215 (1935).

[2] Penard, E., *Arch. Protistenk.*, **28**, 78-140 (1912-13).

Radium Treatment

Reference is made in Nature of December 9, 1939, p. 973, to a paper (*J. Roy. Soc. Arts*, Dec. 8, 1939) entitled "The Penetration of Rays through the Skin, and Radiant Energy for the Treatment of Wounds", in which I express the view that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there, and states that the Cancer Act is Great Britain's reply to the question whether monetary influence determines the practice of radium therapy in Great Britain.

Radium, a destroyer of living cells in active division, cannot be used to attack cancer without also damaging living normal cells of the circulating blood, etc. It can only be used for accessible cancers in the skin or surfaces of the body, which can be removed in nearly all cases by the knife or the diathermy needle of the surgeon; and these last do not cause necrosis and incurable neuralgias, which have often followed the use of radium. Deaths due to leucopænia have resulted from vain attempts to cure deep cancers by the use of radium in bombs. I can instance the damage done by radium by a case now attending the St. John Clinic and Institute of Physical Medicine; radium treatment of a small epithelioma in the skin on the side of the skull resulted in necrosis of the bone, probably incurable, in an area the size of the top of a sherry glass.

Loss of well-being and an incurable neuralgia were recorded by Mr. Furnival, the late distinguished surgeon, who died not long after radium treatment, in his case of cancer of the throat. Such an intolerable neuralgia was suffered by a relative of mine through treatment of a cancer of the root of the tongue, and he also died of a recurrence; and I have heard of many other such cases. There are good clinicians who hold the view that the use of radium favours the spread of metastases. Radium is popular because it can be used instead of the knife, which people dread, and therefore doctors use it.

X-ray apparatus is now available which operates at a million volts or more, so that radiations approaching those of radium are produced. The dosage of radium is controlled by time and filtration; that of X-rays can be further controlled in wave-length and intensity. Radium may be chosen as more convenient for application in such a place as the larynx.

Both radium and X-rays can produce, not only necrosis, but also cancer, and Sir Norman Walker considers that the use of X-rays for lupus should be abandoned. I know of an excellent laboratory servant who, only by continued observation and treatment, is kept, so far, free from cancer resulting from scars due to X-ray treatment of lupus of the face.

We know that death has resulted in several workers who licked the paint off brushes when applying luminous, radioactive paint to watch dials, and cancer has resulted from a radium tube being left in the body. Those who mine radium-bearing ore die generally from cancer of the lung.

The *Lancet* (Dec. 23, 1939) says, "to ensure that radiation treatment is in charge of really competent workers, and to give opportunities for training therapists, a high degree of centralisation will be more effective than the creation of individual treatments units". "To use both radium and X-rays to the best advantage some surgical training and a good grasp of radiation physics are needed, and for the purpose of the Act clinical knowledge of cancer in all its manifestations as well".

While vast sums have been spent on radium, numbers of poor people have to die, unrelieved, of cancer, in their homes. The pressing needs are to spread knowledge, secure prevention where possible, and very early diagnosis, allowing a hopeful removal by the knife or diathermy needle, which can be used by surgeons everywhere, the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult, and to be used by specialists as the *Lancet* suggests. There is no trustworthy evidence that radium in weak doses has any beneficial action.

Leonard Hill.

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Jan. 5.

"Evidence for Transformation of Mesotrons into Electrons"

In our note under this title published in Nature of January 20, p. 102, we stated in reference to the cloud photographs reproduced that the faint electron track *FG*, leaving the end of the mesotron track "is comparable in density with the tracks of other fast particles" in the photograph. This was the case in the original negatives, in the prints submitted for publication, and in the first proofs received, except that in the latter all the tracks were fainter. However, in Fig. 1 of the published note, the track *FG* appears much more pronounced and thicker than in the original prints—being quite obvious while other electron tracks in the same region are scarcely detectable. A new set of blocks was made for the final publication; the Editors assure us that no part of Fig. 1 received preferential treatment and suggest that the great intensity of the track concerned may have arisen from a very favourable inclination of its direction with the mesh of the screen used in reproduction.

We take this opportunity of pointing out that the arrow pointing to the δ-track at *E* in Fig. 4 should be about 2 mm. lower.

E. J. Williams.
G. E. Roberts.

"Victorian Socialism"

IN a very interesting essay entitled "Victorian Socialism" which Dean Inge contributed to NATURE of January 13 as if it were a review of my "New World Order", he makes certain statements for which I think it is reasonable to demand documentation. He says that the Nationalists (that is, the Franco rebels) took arms "against those devils in human shape, the Spanish Reds", etc. But is it not a matter of fact and common knowledge that Franco led his Moors against a Liberal Republican Government which had recently suppressed a very dangerous anarchist-socialist rising? (see Sender's "Seven Red Sundays", translated by Sir Peter Chalmers Mitchell, F.R.S.). Further, he gives an explicit account of abominable atrocities committed at Ronda. But surely in NATURE we want something more than an unnamed "American eye-witness" for statements of that sort. Who was he? How can we check his testimony? Is he available for cross-examination? Then about that three hundred thousand men and women "butchered under orders from Moscow". Is there a single respectable scrap of evidence for any part of that statement. Which we may find quoted presently as a statement made in NATURE.

H. G. WELLS.

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Regent's Park, N.W.1.

I HAVE made a careful study of the Spanish horrors, and have accepted none but well-documented evidence. The Ronda story is from a book by Arthur Bryant. I could have found several equally dreadful examples by Spanish eye-witnesses, but some of them I did not care to keep on my shelves. The estimate of 300,000 victims is official; some have put the number much higher. Krivitsky's "I Was Stalin's Agent" is most illuminating; for example, p. 120: "The Ogpu had done a brilliant piece of work. In Dec. 1936 the terror was sweeping Madrid, Barcelona, and Valencia. The Ogpu . . . carried out assassinations and kidnappings. . . . The Soviet Union had a grip on Loyalist Spain, as if it were already a Soviet possession." This book may be enough for my friend Mr. Wells, who is a very honest man.

W. R. INGE.

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Wallingford, Berks.

Scientific Workers and the Armed Forces

THE announcement published in NATURE of January 13, p. 61, "that the operation of the Schedule of Reserved Occupations is being relaxed to enable men at or above the age of reservation in scientific occupations to volunteer in approved cases for service in the Forces" calls for certain comments.

The increase in unemployment among scientists, particularly chemists and biologists, which may be the cause of this relaxation of the schedule and is the cause of much concern in this Association, is largely due to the reduction of 'civilian' research and the impossibility of absorbing all these scientists into direct war research. Through the somewhat uneven incidence of the economy campaign, many lines of research are already in jeopardy; it is only necessary to mention the example of food research. In the leading article of the same issue of NATURE, suggestions are made for new lines of research directly related to the needs of the population in war-time. In addition to such lines of work, there can also be suggested scientific work which is of less direct importance to a country at war but should be inaugurated at once so that its results may be available when required. The most obvious example of this kind of work is research on problems of substitute materials, in which Germany is at present probably ahead of Great Britain.

The fact that chemists and other scientists are now allowed to enlist in the Forces in other than their professional capacity suggests that there is a shortsightedness in the scientific direction of the country.

W. A. WOOSTER.
(Hon. General Secretary.)

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Points from Foregoing Letters

THE ordinary form of quartz with trigonal symmetry changes at 575° to a form with hexagonal symmetry, the change being preceded by a progressive change of physical properties. Sir C. V. Raman and T. M. K. Nedungadi find an explanation for these effects as a result of an examination of the scattering of monochromatic light in quartz at various temperatures up to the transition point.

The First Benedicks effect (passage of an electron current in a metal subjected to a temperature gradient) in gas-free mercury has been re-examined by C. Benedicks and P. Sederholm. They find that the effect increases rapidly with increase of the mean temperature of the metal, the law of increase being similar to that for the emission of electrons into a vacuum (Richardson's law).

The principal diamagnetic susceptibilities of the diphenyldiacetylene molecule have been measured by K. Lonsdale. A concentration of electron density normal to the carbon chain axis is indicated by a comparison of the results with those previously found for tolane.

Independent X-ray crystallographic examinations of phosphorus pentachloride by H. M. Powell and D. Clark in Oxford and by A. F. Wells in Cambridge have established the constitution of this compound in the solid state. The structure contains tetrahedral $[PCl_4]$ and octahedral $[PCl_6]$ groups.

H. O. Jenkins finds that linear relations exist between the complexity of degeneracy, defined in terms of the number of possible resonating structures, and the dissociation constants of series of related acids and bases.

C. L. Duddington describes four species of predaceous Phycomycetes, belonging to the Zoopagaceæ, found in leaf-mould from the Cotswolds.

RESEARCH ITEMS

A Neolithic Trackway

A possible Neolithic trackway across the Cotswolds has been traced by Miss C. A. Simpson and Miss Clifford and is described by them in *Geography* of December. It extends north-eastward from Bisley by Duntisbourne, Chedworth and Northleach to the edge of the low and swampy ground of the Windrush valley west of Bourton-on-the-Water, where it swings north and then west towards Nutgrove and beyond. In Neolithic times the limestone plateau of the Cotswolds was probably covered by low scrub and there were few trees. The valleys, however, were mainly floored by clay and sand, and afforded marshes which restricted the crossing places. On the plateau the trackway is less easy to trace, for it was probably less well defined. Long barrows in conspicuous places were probably landmarks and also the objectives of some of the travellers. Flints and stone weapons are also useful clues. On the valley sides, however, the track is frequently sunk either in clay or limestone outcrops. Projecting spurs of firmer ground often lead to the river crossing. In some places the route follows a line of present road, but more often it is marked, if marked at all, by a narrow lane, a bridle path or even a double line of hedge. The authors' discussion of the evidence to be sought in tracing the trackway has many useful indications for such work.

Feet of Melanesians and Europeans

A study of the footprints of sixty-five natives of the Solomon Islands by Clifford S. James, of the Melanesian Mission Hospital, Malaita (*Lancet*, 237; Dec. 30, 1939), affords material for contrast with those of Europeans. The longitudinal arch exists in both Melanesians and Europeans and is a definite fixed part of the anatomy. This is contrary to the view recently expressed that there is no fixed arch "in primitive races who have never worn boots or shoes". As regards differences between the foot of a European and the Solomon Islander, that of the latter is more massive and broader, especially in the male, lacking the 'elegance' (usually pathological) of the European foot. The toes of a native are straight, lie parallel with the ground, and are spread out so that the inner and outer borders of the foot are two straight lines. Occasionally the great toe is abducted so that the inner border of the foot is concave medially, and the other foot has to 'step over' the great toe. A native in walking uses his toes more than does a European; and the final push-off is from the toes. The most obvious difference in the two footprints is that the European's foot is always turned outwards to various degrees when walking, while that of the native has its inner border pointing straight ahead with slight variations one way or another. The female foot being less massive than the male, its mobility and pliability are most noticeable, especially as shown in the way the foot spreads out over the ground when the body weight is put on to it. The print of a European aged 5½ years who had never worn shoes, when superimposed on that of a native, showed striking similarities. Flat-foot does not occur among the natives.

Biological Control of a Fungus Disease

The honey fungus, *Armillaria mellea*, is of world-wide distribution. It is widespread upon forest trees in Great Britain, and is very destructive to tea plantations in Nyasaland. R. Leach has made some interesting experiments on biological control of the disease in the last-mentioned venue (*Trans. Brit. Mycol. Soc.*, 23, Pt. 4; December 1939). Forest land has to be cleared of trees before tea bushes can be planted. The fungus attacks roots left in the soil, and later can transfer its parasitism to the economically valuable bushes, with disastrous results. Cutting a ring of bark from trees some time before they are felled, however, depletes the roots of carbohydrates, and thereby deprives *A. mellea* of an acceptable substrate. It does, in fact, effect such a large edaphic change that other organisms establish themselves in the decaying roots, and exclude the parasite, which can even be prevented from spreading by felling a belt of bark-ringed trees.

New Descriptions of Agarics

The Aviemore foray of the British Mycological Society yielded some interesting new records of Agaricaceous fungi, mostly of the genus Russula, which are described by A. A. Pearson in the Society's *Transactions* (23, Pt. 4; December 1939). Several of the species, as *R. rosea*, *R. vinosa and R. gracillima*, have occurred in other countries, but a new species, *R. scotica*, is also delineated. This is similar to *R. cremeo-avellanea*, which is found in the Pyrenees; but differs in the non-reticulated spore and absence of cystidia on the pileus.

Shoot Wilt of *Prunus triloba*

The fungus *Botrytis cinerea* is often thought of as a saprophyte, but it has been found to show active parasitism upon some plants. W. C. Moore has recently described a shoot wilt disease of *Prunus triloba*, caused by this organism (*Trans. Brit. Mycol. Soc.*, 23, Pt. 4; December 1939). New shoots wilted suddenly shortly after flowering, the bark died and it became brown. A wilted flower cluster was always associated with such shoots, and the disease appeared most severely when the weather was wet before the end of May. Pathogenicity of the organism mentioned was proved by isolation and re-inoculation.

Theory of Differential Periodicity

G. F. Sleggs (*Growth*, 3, 173–179; 1939) puts forward a theory of gene structure and development of the organism which is based on the interactions of protein lattices. If one projects all the genes, cytoplasm and other intergenic material in every cell of the organism into one structure, the author considers that the genes are equivalent to a stack of horizontal lattices differing in spatial period. Growth then is basically a process of lateral extension of the vertical strips of the lattice system. The minimum effective fragment will be a chain of the mesh, for example, the spireme. The equipotentiality of the system lies in the fact that any vertical strip can regenerate the whole differential pattern of the lattice stack. All genes are thought to be similar, differing only in spatial arrangement. The differential in the amino-acid frequency is believed to result from gene rotation. On this view it is possible to account for differential mitosis, the relationship between cytoplasmic and other intergenic material and growth phenomena, and evolutionary trends by the conception of rotations in a protein lattice stack.

Genetics of *Primula kewensis*

MOST interesting facts have resulted from the examination of *Primula kewensis* by M. Upcott (*J. Genetics*, 39, 79–100 ; 1939). There are two types of tetraploids known ; the first resulted from the doubling of chromosomes in branches of the diploid cross *P. floribunda* × *P. verticillata* ; the second arose from backcrossing the first type to *P. floribunda*. The first contains two complements each of *floribunda* and of *verticillata* chromosomes while the second contains three sets of *floribunda* to one of *verticillata*. The diploid, sterile *P. kewensis* forms bivalents and one to two pairs of univalents. The sterility of the hybrid is not due to difficulties of chromosome pairing. Evidence has been provided of the manner in which gametes with less than the normal reduced number of chromosomes may occur. 8 per cent of the pollen grain division of the tetraploid *P. kewensis* showed "double plates" ; that is, either several chromosomes lie off the main divisional plate and form a secondary plate on their own or the mitotic spindle is curved. Should the chromosomes forming the secondary plate be a compatible complement, say $n = 9$, there is a chance of gamete production with 9 chromosomes in place of the normal 18 from tetraploid *P. kewensis*. It is shown that tetraploids have consistently a lower chiasma frequency than the related diploids.

Quantitative Characters

LEROY POWERS (*J. Genetics*, 39, 139–170 ; 1939) describes an experiment in *Lycopersicum esculentum* and *L. pimpinellifolium*, in which the analysis of variance is applied to the study of the inheritance of the number of locules and the size of fruit. He shows how the analysis of variance may be usefully applied to genetical problems. Variances were heterogeneous for "between genotypes" and for "between generations" and, to some extent, for "between sampling blocks". The variability of the variances is a function of genotypes. There would appear to be at least three pairs of allelomorphs involved in the determination of both number of locules and size of fruits. Their interactions are geometrically cumulative, but it is shown that interactions between pairs of allelomorphs are different from those within pairs, and proper experimental methods should be adopted to keep these differences distinct.

Greenland Ice Sheet

THE advance and retreat of valley glaciers is frequently cyclic and not progressive in either direction. It is often more dependent on local topography than on changes in climate. In recent observations in north-west Greenland ("Contributions to the Glaciology of North-West Greenland", *Meddelelser om Grønland*, 125, No. 3), J. W. Wright shows that advance and retreat have occurred in the Moltke Glacier this century, but agrees that other evidence than that of valley glaciers is required for movements of the ice cap. This evidence he believes he has found, pointing to a recent retreat of the ice cap in Inglefield Land. Several new nunataks have appeared during the last few years ; their appearance is vouched for by Eskimos. A long narrow lake, on the ice-free land, but adjoining the ice cap, has lately undergone a drop in level as shown by the former strand line ; presumably its outlet until recently was dammed by a tongue of the ice which has now disappeared. Further evidence of retreat is the occurrence along the edge of the ice cap of rock not yet bearing the normal covering of lichen. Lastly, Mr. Wright cites the disappearance during the last ten years of an ice cap covering a small island and the melting of the snow drifts that were perennial on the slopes east of Thule.

Microseisms and Transmission of Atmospheric Disturbances

As the result of the mathematical examination of an ideal case in which atmospheric disturbance is transmitted through a layer outside or within which a steady air current is blowing, Katsutada Sezawa and Kiyoshi Kanai (*Bull. Earthquake Res. Inst. Tokyo Imp. Univ.*, 17, Pt. 3, 548–557 ; 1939) arrive at some interesting conclusions. When it is possible for the disturbance to be transmitted through such a layer, the amplitude of the waves becomes a maximum for a certain range of periods, which condition would be one of the important causes of microseismic oscillation. It is possible for there to be two kinds of waves transmitted along this ideal atmospheric layer ; one has a velocity comparable with that of sound waves and the other has a velocity of the order of a small fraction of the velocity of sound waves. Waves of both these kinds are transmitted only in the same or the reverse direction of the wind. The condition determining such a direction of wave transmission depends on wind velocities both in the upper and lower atmospheres. It is pointed out that microbarometric records register an aggregate of local disturbances of smaller periods, particularly those of a gravitational nature, and it may not be possible to pick out the main oscillations of smaller periods that occur in a relatively large area. For this reason it may not be possible to show any correspondence between microbarometric oscillations and microseismic oscillations.

Use of Monochromatic Image in the Spectrohelioscope

M. A. ELLISON has published a paper on the formation of the monochromatic image in a spectrohelioscope (*J. Brit. Astro. Assoc.*, 50, 2 ; 1940) which will prove very useful to solar observers. As it deals with various details too numerous to summarize in a short space, those who are interested in the subject are referred to the original paper. Briefly, Ellison considers the three possible arrangements for the 'scanning' and 'viewing' slits, and points out the advantages as well as the disadvantages of each one. He refers specially to the convenience when the slits are placed side by side, about five inches apart and parallel to one another, a method adopted by F. J. Sellers, director of the Solar Section of the British Astronomical Association. A description of the apparatus has already appeared (*J. Brit. Astro. Assoc.*, 48, 6 ; 1938) and Ellison has used a similar apparatus with his spectroheliοscope, the results being very satisfactory. A short account is given of the Anderson prism device, which is an alternative to the slit mechanism and was applied by Hale to the spectrohelioscope.

FURTHER APPLICATIONS OF THE PHOTOGRAPHIC METHOD IN NUCLEAR PHYSICS

By Dr. C. F. Powell,

The Wills Physical Laboratory, University of Bristol

In a letter published in Nature of July 15, 1939, p. 115, attention was directed to the fact that the photographic plate provides a very powerful instrument for investigations depending on the detection and measurement of the energy of heavy charged particles, notably protons, and of neutrons. It was shown that the method, when applied to determining the energies of the neutrons liberated from the light elements under deuteron bombardment, yields essentially the same information as that provided by the expansion chamber. The photographic method has, however, marked advantages over the expansion chamber, which were described.

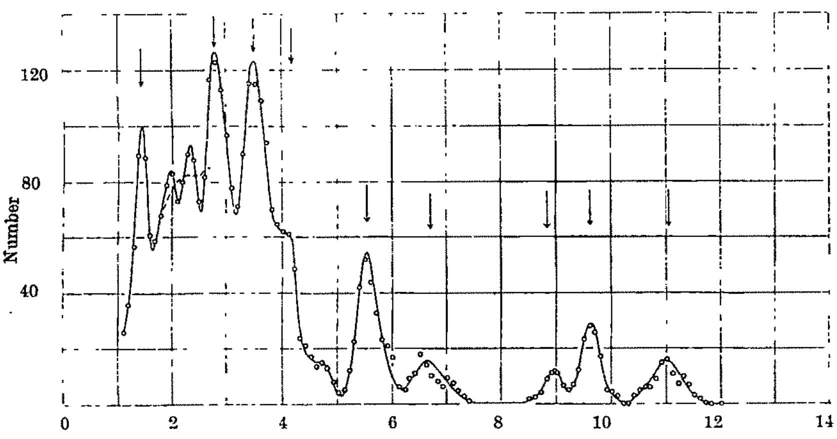

Fig. 1.

Forward neutrons from F + D at 900 kv.
Number per 200 kv. range plotted for every 100 kv. Peaks statistically justified are shown by arrows. Two tracks were also observed, at 13·2 and 13·6 eMv. respectively, which suggest slight boron contamination of the target.

The first experiments were made on neutrons of which the energy spectrum had already been investigated. It was, therefore, of importance to apply the method to an investigation in which previous work could not serve as a guide able to prejudice the experimental observations. Adequate checks were applied in the previous work and it is believed that the results are free from this objection, but nevertheless an independent experiment was desirable. Through the courtesy of Prof. J. D. Cockcroft and Mr. P. I. Dee, it was possible to examine the neutrons from fluorine under bombardment with 900 kv. deuterons from the Cambridge one million-volt generator. The results are shown in Fig. 1, and are taken from measurements on 1,700 tracks contained in 4 sq. cm. of an Ilford half-tone plate of which the emulsion was 100 μ thick. The results were obtained with an exposure of two hours with 30 microamperes in the resolved deuteron beam, the plate being at a distance of about 10 cm. from the target and in a position to detect forward neutrons. The measurements of the tracks were made by a single observer in about sixty working hours. We understand that the same spectrum has been investigated by Dr. T. W. Bonner using the expansion chamber, and that his results will be published shortly. We have not seen his results, and it will thus be possible to make a completely independent check on the validity of the photographic method. Two tracks of 13·4 eMv. protons suggest boron contamination of the target, and this may be responsible for the peaks at 4·3 and 9·0 eMv. Further work will be necessary to decide this point.

It was suggested in the previous letter that the photographic method is equivalent to a continuously sensitive expansion chamber. We believe it possible to press the analogy further in the sense that the spatial orientation of a track in the emulsion can be determined. With objectives of high aperture, the depth of focus is so small that it is possible to determine the depth of individual grains in the emulsion with a high degree of precision, and hence the angle of inclination of a track to the plane of the plate. In addition, the direction of the projection of the track on the plane of the plate can be measured to within a quarter of a degree and the direction in space thus defined. We have examined the distribution in angle of the protons ejected by the neutrons from boron under deuteron bombardment as they pass though the plate.

We and other observers have shown that the high-energy neutrons from this reaction fall into four groups with energies of approximately 4, 6, 8·7 and 13·3 eMv. when the bombarding deuterons have an energy of 600 ekv. If a neutron of energy E_0 is scattered by a proton, the energy acquired by the proton, if projected at an angle β with the direction of the incident neutrons, is $E_0 \cos^2\beta$. If we measure the range of protons projected in a photographic plate by the boron neutrons, we should therefore expect the ranges of the observed tracks to be distributed, according to the angle β, in a way corresponding to this energy equation. We should expect the points to lie, not on four lines, but within four bands as a consequence of:

(a) the straggling of the protons,

(b) the uncertainty of ±2° in the direction of the neutrons entering the plate, owing to the width of the deuteron beam striking the target, and

(c) an uncertainty of ±1° in the determination of β.

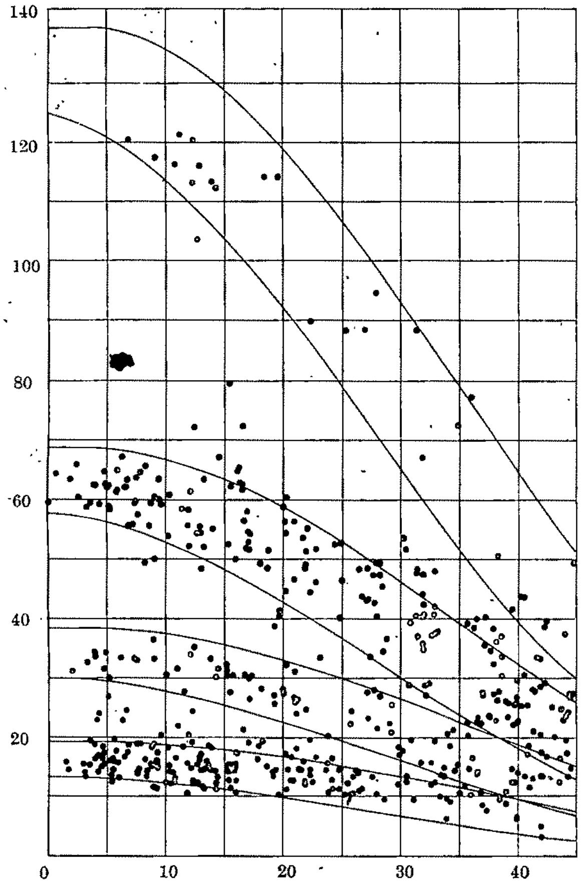

Fig. 2.

DISTRIBUTION OF RANGE WITH ANGLE FOR 500 PROTON TRACKS SCATTERED BY B + D NEUTRONS.

Tracks measured make angles up to ± 12° with plane of the plate. Range is plotted in microscope eyepiece scale divisions.

The bands shown in Fig. 2 are drawn by assuming a 'width' of 0·8 eMv. in the range at any angle due to straggling, and an uncertainty of ±3° in the determination of β due to factors (*b*) and (*c*). The results for the first 500 tracks measured are shown as points in Fig. 2, and it will be seen that 90 per cent of the tracks lie within the four bands. The results emphasize in a striking way one of the conclusions of the previous letter, that the photographic method has the advantage over the expansion chamber in that the amount of matter in the plate is so small that it does not give rise to scattered neutrons in serious numbers, and show that it is possible to investigate neutron-proton scattering at high energies by the photographic method. The measurements are proceeding.

The possibility of determining γ-ray energies by means of the photographic plate has also been investigated. Plates loaded with heavy hydrogen were exposed to the γ-rays from fluorine under proton bombardment and a search made for the photo-disintegration protons. The difficulty is that the cross-section per atom for the production of electrons in the emulsion by the γ-rays is about a thousand times greater than that for the photo-disintegration of the deuteron. Although many electrons must pass through a grain before it will develop, a limit is thus imposed on the time of exposure to which the plate can be subjected, beyond which the general background of fog makes it impossible to distinguish proton tracks. With the first plates available the deuterium content was too small to give a sufficient number of tracks per sq. cm. of the plate at the limiting γ-ray exposure. A layer of 'heavy' ammonium chloride, $(ND_4)Cl$, was therefore supported immediately above an ordinary half-tone plate during an exposure to the γ-rays. A large number of proton tracks was then observed in the developed plate, starting in the surface of the emulsion, and having a maximum energy of 2 eMv. We attribute these to the photo-disintegration of the deuterium under the action of the 6 eMv. γ-rays from the fluorine.

Although the application of the method to the determination of γ-ray energies can only be made in the absence of neutrons, it can be used in its present form to determine the spatial distribution of protons from the photo-disintegration process, an experiment which is of great importance for the meson field theory. This experiment, and further work with plates loaded with greater amounts of heavy hydrogen, is proceeding.

It is evident from the results published in our previous communication on the protons from the reaction $B^{10}-d,p$ that the photographic method can be applied to scattering experiments between fundamental particles, p—p, p—d, p—α, etc., using the high-energy protons provided by the cyclotron, and we are at present collaborating with Prof. J. Chadwick on such experiments. Dr. T. R. Wilkins kindly informs me in a private communication that he is investigating proton-proton scattering at high energies by a similar method. The great advantage of the method for such work is that, in contrast with experimental methods employing counters, the particles scattered through different angles are all recorded at the same time, so that it is not necessary to apply elaborate corrections for maintaining the constancy of the bombarding stream or correcting for its variation. The analysis of the plates is much easier in these experiments than with neutron work, since the scattered particles all start in the surface and run parallel into the plate. Dr. Wilkins employs a camera carrying a large number of plates in this

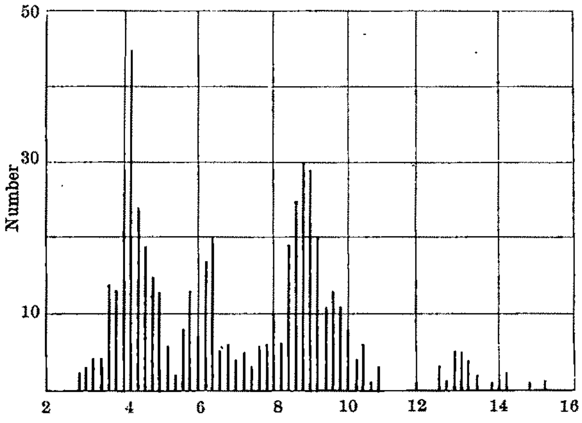

Fig. 3.

ENERGY DISTRIBUTION FROM ALL MEASURED TRACKS PROJECTED WITHIN 40° OF THE DIRECTION OF THE INCIDENT NEUTRONS.

type of experiment. We use a single rectangular plate with the proton beam running parallel to the long axis and a little above the plate. The beam, defined by stops, passes down the axis of a tube provided with a short interruption through which protons scattered by the gas in the camera can emerge to enter the plate.

A detailed account of the methods employed will shortly be submitted for publication in another place. It may be mentioned here that we find it a considerable advantage to use binocular microscopes and optical equipment of the highest quality to reduce the nervous strain on the observer to a minimum. Although the Ilford half-tone plate has proved very adequate for the work, it seems likely that it will be possible to develop special plates with superior characteristics for nuclear work.

THE VOCODER

AT the World's Fairs in New York and San Francisco great interest was shown in the speech synthesizer shown in the Bell System exhibits. In the December number of the *Bell Laboratories Record*, H. Dudley, of their research department, describes this device, known as the 'vocoder'. The 'voder' is an offshoot of a more extensive system first demonstrated in its experimental stage several years ago. It first analysed spoken sounds and then used the information to control the synthesizing circuit. As World's Fair displays were then under consideration it was seen that the synthesizer, manually controlled, could be made into a dramatic demonstration. Development was at first concentrated in this field, but when a successful Voder became assured, attention was shifted back to the broader and parent system and it was called the 'vocoder', since it operates on the principle of deriving voice codes to re-create the speech which it analyses. The analyser is at the left and the synthesizer at the right of the vocoder.

Electrical speech waves from a microphone are analysed for pitch by one channel and for spectrum by a group of channels. In the pitch analysis the fundamental frequency is called for simplicity the pitch. It is measured by a circuit containing a frequency discriminating network which obtains the frequency in a pure form, a frequency meter for counting, by more or less uniform pulses, the current reversals therein, and a filter for eliminating the actual speech frequencies but retaining a slowly changing current that is a direct measure of the pitch. The output current of the pitch channel is then a pitch-defining channel with its current approximately proportional to the pitch of the voiced sound and equal to zero for the unvoiced sounds.

There are ten spectrum-analysing channels, the first handling the frequency range 0–250 cycles and the other nine, the bands, 300 cycles wide, extending from 250 cycles to 2,950 cycles, a top frequency which is representative of commercial telephone circuits. The operation of the analyser is illustrated by a group of oscillograms taken in analysing the sentence "She saw Mary". In the analyser the speech wave is the input and the eleven speech-defining signals are the output; in the synthesizer the eleven speech-defining signals are the imput and the speech wave the output. The relaxation oscillator is the source of the buzz, and the random noise circuit the source of the hiss. When a voiced sound is analysed a pitch current other than zero is received, with the result that the buzz is set for the current pitch by the "pitch control" on the relaxation oscillator; also, the relay marked "energy source switch" operates, switching from the hiss source to the buzz source. From the loud-speaker comes speech approximately the same in pitch and in spectrum as the original.

The possibilities of the Vocoder were recently demonstrated by the author before the Acoustical Society of America and before the New York Electrical Society. In these demonstrations comparison is first made between direct speech and the best re-creation that the apparatus could make. Then by manipulation of dials and switches, speech is modified in various ways. Normal speech becomes a throaty whisper when the hiss is substituted for the buzz. Although the hiss is relatively faint, it is shown to be essential for discrimination between words like 'church' and 'shirts'.

Ordinarily the re-created pitch moves up and down with that of the original. If variation is prevented, the re-created speech is a monotone like a chant. When the relative variation is cut in half, the voice seems flat and dragging; when the swings are twice normal, the voice seems more brilliant; when four times normal it sounds febrile and unnatural. The controls can be reversed, so that high becomes low; the tune of a song is then unrecognizable, and speech has some of the lilting characteristics of Scandinavian tongues. By appropriate setting of the basic pitch, the voice may be anything from a low bass to a high soprano. If the basic pitch is set to maintain a constant ratio of, say, 5 to 4 to the original, this is a 'major third' higher and harmonizes with the original. In two-part harmony, the demonstrator can then sing a duet with himself. Connecting a spare synthesizer for a 3 to 4 ratio he can sing one part in a trio, the others being taken by his electrical doubles. Finally, with the basic pitch control of the apparatus, he becomes a father reprimanding his daughter, then the girl herself, and then becomes the grandfather interceding for the child. Keeping careful time with the puffs of a locomotive, the demonstrator can make the locomotive puff intelligibly "We're—starting—slowly—faster, faster, faster" as the puffs come closer together. A particularly striking effect is that of singing with an organ to supply the tones. Although the words may be spoken, the demonstrator usually sings them to hold the rhythm. It makes no difference whether his voice is melodious or not; the tonal quality comes only from the musical source.

The engineering possibilities which may grow out of the application of the principles employed in this device are hard to predict at the present time. The speech-defining currents, however, do have features of simplicity and inaudibility which may open the way to new types of privacy systems or to a reduction in the range required for the transmission of intelligible telephonic speech.

CATLIN AND HIS NORTH AMERICAN INDIAN GALLERY AND MUSEUM

BY L. J. P. GASKIN

FEBRUARY 1 is the centenary of the opening of "Catlin's North American Indian Gallery and Museum" in the Egyptian Hall, London. George Catlin, American artist, traveller, and ethnographer, spent eight years, 1830–38, among the Plains Indians of North America, and was familiar with their life and customs at a time when the Indians were still living far from that civilization which was to overtake and destroy them so rapidly. His declared purpose from the outset was to preserve for posterity the likeness of aboriginal man in America, and his artistic ability and industry in this direction was shown to great advantage by more than six hundred portraits and sketches of the Indians, and of Indian life, hung round the walls of the Egyptian Hall. The Museum contained thousands of objects of Indian manufacture such as weapons, costumes, musical instruments, and domestic utensils so arranged as to form a pictorial history of those tribes thought particularly worthy of notice. In the centre of the room was erected a large wigwam from the country of the Crow Indians, made of buffalo skins, curiously ornamented with porcupine quills, and capable of housing eighty persons.

The history of the exhibition is interesting. After a four-year sojourn in London and the provinces it was removed to Paris, where it attracted the attention of Louis Philippe, who permitted it to be shown in the Louvre. Unfortunately, this Royal interest involved Catlin in great difficulties when the July Revolution of 1848 compelled him to leave France. Once again in London, he sought to recoup his losses by the rehabilitation of his exhibition, and this led to financial disaster: his collections were seized for debt, though they were freed later through the generosity of a fellow-countryman.

In 1852, Catlin set out on his travels once again, and on this occasion visited Central and South America. He returned to Europe in 1858, and busied himself with the formation of his "Cartoon Collection", copies of his original pictures, and much new matter from his later travels. He returned to America in 1870 to show this second collection in the Smithsonian Institution, and died in 1872.

For forty-two years he had laboured to improve and perfect his Indian collections, and to plead the Red Man's cause. His writings, particularly his "Letters and Notes on the manners, customs, and condition of the North American Indians" (1841), made him and his work known to a large circle of readers in Europe and America, and his portraits and sketches have been declared, by those well qualified to judge, as among the most truthful of the Red Indians ever presented to the public. But the most enduring monument to his memory will always be his two collections, now housed in the United States National Museum and the American Museum of Natural History.

NEWTON'S KNOWLEDGE OF THE RADIUS OF THE EARTH

IN a paper entitled "The Story of Newton's Inverse Square Law and his Use of a False Radius of the Earth" (*J. Brit. Astro. Assoc.*, 50, 2; 1939), John Miller states that the story of Newton's alleged ignorance of the true radius of the earth is open to considerable doubt. The data at the disposal of Newton were the time the moon required to revolve around the earth and the moon's distance from the earth in terms of the earth's radius. The latter was known from the days of Greek astronomy to be about 60, and this was independent of the true radius of the earth. A few simple formulæ are derived by Mr. Miller, and from these a relationship is established between the true radius of the earth and certain constants, the basic assumption being the inverse square law. Miller's final formula enables the true radius of the earth to be found, but, of course, if a false value of the radius is used in this formula, the equality breaks down; in other words, the inverse square law seems invalid. It is alleged that Newton took the radius of the earth to be 3,440 miles, and as it was impossible to fit this value in with the inverse square law, his work was delayed nearly twenty years.

It is generally believed that Newton accepted the value of one degree of latitude as 60 miles, hence his difficulty with the fictitious radius of the earth, but, as Miller points out, Snell's measurement in 1617 gave 66·6 miles and Norwood showed in 1637 that 69·5 miles was a close value, while two years later Picard found a more accurate result, slightly less than Norwood's. It is remarkable that Newton did not make use of any of these in 1665–66 when he was engaged on his gravitational theory at Woolsthorpe. It is certain that he knew Snell's value in 1672, ten years before he was supposed to have recomputed his earlier results, because Varen's "Geography", published in 1672, contains an error which Newton corrected by using Snell's value for the length of a degree of latitude. Picard's accurate results were communicated to the Royal Society in 1672 on the day that Newton was elected a fellow, yet the story goes that he did not make any use of these until 1682. This delay of ten years seems inexplicable.

From an examination of the evidence from various other points of view, Mr. Miller concludes that the story is unauthenticated and that the real reason for Newton's delay of seventeen years in the publication of his "Principia" was the difficulty that he experienced in dealing with axial rotation, a problem to which Miller hopes to return in a subsequent paper.

ELECTRICITY AND GAS INSPECTION SERVICES IN OTTAWA

THE annual report of the Electricity and Gas Inspection Services of Ottawa for the fiscal year, ended March 31, 1939, has been published (Ottawa: King's Printer. 25 cents). It is addressed to the Department of Trade and Commerce, and describes the activities of the Electricity and Gas Inspection Branch from March 1938 until February 1939, with the work performed during the previous year. So far as the Electricity and Gas Inspection Services are concerned, the work performed creates a record. The total revenue was £2,400 more than the preceding year and there were 21,000 more meters tested. A decrease in the surplus is mainly due to the fact that the salaries of the headquarters staff are included in the statement for the first time. The amounts required to cover rent, fuel and furniture for the Services as a whole are not included in this summary. The expenditures incurred in the administration of the Electricity and Fluid Exportation Act are included in the amount charged against electricity inspection. This amounted to about £40.

Calorific tests of manufactured gas were made throughout the Dominion and the average heating value was found to be 489 B.T.U. per cubic foot. The standard required is 450 B.T.U. per cubic foot. The amount of natural gas supplied throughout Canada during this period was approximately 32,000 million cubic feet, an increase of 5½ millions over last year. The total number of meters in service on March 31, 1939, was approximately two million, an increase of nearly 60,000 over the preceding year.

The periodic calibration and checking of the inspection standards, supplied to the various inspectors throughout Canada for outside companies and other departments of the Government, is performed in the laboratories of Ottawa, Winnipeg and Vancouver. The expenditure on electricity inspection was £55,000 and on gas inspection was £15,000.

The number of kilowatt-hours of electrical energy produced for export during the fiscal year 1938–39 was 1,940 million, an increase of 100 million over the preceding year. The number of kilowatt-hours produced for use in Canada by the exporting companies was 3,100 million electric units, as compared with 4,132 million during the previous year. The revenue collected by virtue of the export duty of 0·03 cent per electric unit shows a slight increase over the preceding year.

The Range Oil and Gas Company exported approximately 289 million cubic feet of natural gas from the Rogers Imperial structure in southern Alberta during the past year; and the Vanalta Oils, Ltd., exported approximately 27 million cubic feet from the Red Coulee field, also in southern Alberta. No revenue, except the licence fee, ten pounds for each licence, is obtained from this export.

THE McCOMB-ROMBERG SEISMOMETER

MODELS of this new tilt-compensation seismometer have recently been placed in the new seismographic station of the Nebraska Wesleyan University in Lincoln, Nebraska, in the Chicago Seismograph Station, and in Salt Lake City ("New Instruments and Equipment at Coöperative Seismograph Stations of the United States Coast and Geodetic Survey", J. H. Nelson and H. E. McComb, *Bull. Seis. Soc. Amer.*, 29, No. 4, 549–588; Oct. 1939).

A few of its salient features are as follow: It rests on a one-piece brass plate having point-slot-plane positions for the seismometer footscrews. Around the edge of this base plate is a ploughed slot in which the edges of the metal cover rest Air currents and dust are effectively kept away from the boom and optical system. The column is relatively short and well braced against possible side sway. At the top of the column a worm-driven windlass provides easy and accurate adjustment of the length of the supporting wires from which the steady mass is suspended. The boom, a duralumin rod about 12 in. long has at one end a sapphire jewel which rests against a steel pivot mounted in the bottom of the column, and at the other end a vane of electrolytic copper which floats in the field of a cobalt steel permanent magnet. A rough auxiliary pivot with slow-motion screw mounted on the column to work against a brass cup on the boom is provided for protecting the main pivot and jewel at times of installation and adjustment. The mass is of brass, weighing 2,550 gm. The boom, damping vane and oil cup weigh about 130 gm. The magnet is mounted on guides and may be readily removed at times of determining free period and recording decay curves. The air gap may be easily adjusted by means of a knurled-head micrometer screw.

The optical system of multiplying lever and mirrors gives a nominal magnification of about 350. The seismometer cover is of thin sheet aluminium, provided with doors for adjustments and a glass window set so as to reflect stray light downwards and not into the optical system. Both the north-south and east-west components record on one Henson recorder. The speed of the drum is 15 mm. per minute (one revolution per hour), translating about 5 mm. per revolution. It is driven by a 60-cycle 110-volt synchronous motor through a train of cut gears. A single seismogram 12 in. × 36 in. in size is obtained. The east-west component records directly whereas the north-south component operates by reflection from a large first-surface mirror which gives no distortion.

SEVENTY YEARS AGO

NATURE, vol. 1, January 27, 1870

Tyndall on Haze and Dust

THE Friday Evening Discourse entitled "On Haze and Dust" delivered by Prof. Tyndall at the Royal Institution on January 21, 1870, is printed in full. Prof. Tyndall referred to experiments carried out at the Royal Institution, in which he passed a "powerfully condensed beam" of light through tubes originally exhausted and "optically empty", to which air from the laboratory was admitted after passing through potash and sulphuric acid. In every case, floating matter entered the tube, and revealed itself by scattering the light, showing the "conical track of the electric beam". If the air was heated before passing through the drying apparatus, the floating matter was burnt up. "It was therefore *organic matter*". Tyndall then tried different methods of heating the air stream. Imperfect combustion of the particles produced fine blue clouds in the experimental tube, which gave perfectly polarized light at right angles to the illuminating beam. He also reported experiments in which a heated body placed below a cylindrical beam of light produced wreaths of blackness like thick black smoke, due to air currents removing the scattering particles which made the beam visible.

Tyndall then went on to associate the "organic matter" which the flame consumes with the germs causing disease. For this he was taken to task in the leading article in the same issue. "Practically, so far as health is concerned, Prof. Tyndall has given us a scientific account, not only of certain optical properties of impure air, but likewise of the benefit of several popular practices, such, for example, as lighting fires during epidemics to purify the air, the use of gauze curtains in malarious districts as a protection against fever, covering the mouth with a cloth during sleep in fever countries, and the like . . . On the real proximate aerial cause of disease, if such there be, no new light has been yet thrown either by the optician, the microscopist, or the chemist."

FROM a correspondent: "Professor Struthers, of Aberdeen, and Professor Bell, of St. Andrews, hearing that the five ladies who are studying at the Edinburgh University are excluded from the opportunity of studying anatomy there, have severally offered their services as instructors. Many a lady will rejoice that the numbers of those willing and ready to help in the good cause of fuller knowledge for women are increased by two professors, who have bravely come forward with much moral courage and chivalrous feeling."

"WE are happy to be able to announce that the council of the Chemical Society has decided to have a report of their proceedings and an abstract of the papers read before the society drawn up immediately after its meetings, and to offer copies of this report to the editors of journals who may be likely to wish to publish it. The days when the newest results of science were regarded as something secret—or, at all events, of no concern to the ordinary man of education—are gone by, we trust, for ever."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEMONSTRATOR IN BACTERIOLOGY—The Registrar, University, Leeds (February 3).

AN APPOINTMENT IN THE MECHANICAL ENGINEERING AND TRANSPORTATION (POWER) DEPARTMENT of the Indian State Railways—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/4A) (February 12).

LECTURER IN AGRICULTURAL BIOCHEMISTRY in the Massey Agricultural College, Palmerston North, New Zealand—Universities Bureau, 88a Gower Street, W.C.1 (April 15).

TECHNOLOGISTS—The Under-Secretary of State, S.2.G., Department Z.A., Air Ministry, Adastral House, Kingsway, W.C.2 (quoting reference number B.380).

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

London Shellac Research Bureau. Bulletin No. 3: Iodine Values of Lac; Reaction between Halogen and Lac. By Dr. B. S. Gidvani and Dr. R. Bhattacharya. Pp. 14. Technical Paper No. 17: Ethers and Ether-Esters of Lac and their Polymerisation. By Dr. B. S. Gidvani. Pp. 24. (London: London Shellac Research Bureau.) [31

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1939; with Report of the Director of Water Pollution Research. Pp. iii+49. (London: H.M. Stationery Office.) 1*s*. net. [41

Imperial Institute. The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1936–1938. Pp. 453. (London: H.M. Stationery Office.) 7*s*. 6*d*. net. [41

Battersea Polytechnic. Report on the Work of the Session 1938–39, by the Principal, being the 46th Annual Report presented to the Governing Body. Pp. 36. (London: Battersea Polytechnic.) [91

Friends of the Hebrew University of Jerusalem. Annual Report 1938–9. Pp. 16. (London: Friends of the Hebrew University of Jerusalem.) [101

Hull Museum Publications. No. 205: On Dating Old Horse-Shoes. By Dr. Gordon Ward. Pp. v+38+7 plates. No. 206: Excavations at the Roman Town of Brough, E. Yorkshire, 1937. By Philip Corder and the Rev. Thomas Romans. Pp. ii+62+6 plates. (Hull: Hull Museum.) [101

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 2, No. 2, September 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+113–198. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [101

Other Countries

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. The Canadian Mineral Industry in 1938. Reviews by the Staff of the Bureau of Mines. (No. 804.) Pp. iv+102. (Ottawa: King's Printer.) 25 cents. [91

Publications of the Dominion Astrophysical Observatory. Vol. 7, No. 8: The Spectrographic Orbits of the Components of Boss 2112. By W. E. Harper. Pp. 149–154. (Ottawa: King's Printer.) [91

Field Museum of Natural History. Botany Leaflet No. 24: Mistletoe and Holly. By Sophia Prior. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [91

Scientific Publications of the Cleveland Museum of Natural History. Vol. 8, No. 2: A New Arthrodire from the Cleveland Shale Formation. By David H. Dunkle and Peter A. Bungart. Pp. 13–28+plate 3. (Cleveland, Ohio: Cleveland Museum of Natural History.) [91

Department of Agriculture: Tanganyika Territory. Pamphlet No. 24: Reports from the General Experiment Farms 1938. Pp. 48. (Dar es Salaam: Government Printer.) 1*s*. [91

Transactions of the San Diego Society of Natural History. Vol. 9, No. 14a: A New Subspecies of the Western Worm Snake. By Laurence M. Klauber. Pp. 67–68. Vol. 9, No. 15: Two New Pocket Gophers from the Desert Slope of Eastern San Diego County, California. By Laurence M. Huey. Pp. 69–72+plates 4–5. (San Diego, Calif.: San Diego Society of Natural History.) [91

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1932–33. English Version. Part 2. Pp. 478+15 plates. (Cairo: Government Press.) P.T. 100. [101

Catalogues

Old Books of interest to the student of the Social Sciences. (Catalogue 54.) Pp. 42. (London: E. P. Goldschmidt and Co., Ltd.)

Level Measurement and Control. Pp. 24. (London: Negretti and Zambra.)

Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

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SCIENTIFIC PLANNING OF LOCAL GOVERNMENT

IT is becoming a commonplace to say that war is no longer an affair of armed forces alone. Curtailed lighting, restrictions on travel whether by road or by rail, national registration, the rationing of food and of petrol, the exigencies of civil defence, and many other measures have brought home to all that national needs and effort must, on occasion, override all personal and individual considerations. Nothing can be allowed to stand in the way of our immediate purpose, which is to win the war, with the view of establishing an order based on the peaceful settlement of international disputes.

It would be disastrous, however, if the restraints necessarily imposed on individuals in a time of war engendered merely a sense of frustration. Behind even the prosecution of the war lies the purpose of safeguarding our national life and existence, for it is the preservation of our mode of life, with its traditions and heritage of justice and freedom, that has called forth this effort. Nevertheless, the very disturbances and shocks administered to the structure of our national life may loosen obstacles that have hindered its development in the past. Amid all the tragedy and wreckage of war, any opportunity which it may afford to redeem the mistakes of the past should not be forgotten.

There are few fields of planning in which to some extent fresh opportunities are not opening up and possibilities of further progress and development appearing. The organization of national defence has given a fresh impulse to many forces making for regionalism, the co-ordination of local authorities or of public services, the control of the location of industry and like matters. Under the exigencies of war, fresh experience is being gained which should ultimately be of value in the reintegration and development of national life, both under local authority and central government. Particularly is it true that the organization of civil defence, whether in the actual precautionary services against air attack or in the dispersal of population in evacuation schemes, has exposed defects in our administrative system which should be rectified at the first opportunity.

Notable among such weaknesses are the difficulties which local administrative units, often with archaic and thoroughly unscientific boundaries, can put in the way of a uniform and adequate plan of defence; and the failure of such bodies to appreciate the differences between urban and rural conditions and to apply measures appropriate and adequate in each sphere. It is not easy to assess the wastage which has been caused by such weaknesses; but an attempt should be made not merely to eliminate such waste but also to deal with its underlying causes.

An outstanding contribution in this field is Dr. W. A. Robson's study "The Government and Misgovernment of London", which appeared a short time before the War broke out. The attention of scientific workers has already been directed to this book in these columns (NATURE, 144, 846; 1939), but much of the third part of Dr. Robson's book is of general validity and far from being confined to the particular question of London. The issues of regionalism, the principles of democracy involved, no less than those of planning, affect more or less acutely, problems of national and local administration throughout Great Britain, and the stimulating discussion of these matters deserves the careful attention of all those who are determined to seize any fresh opportunities which the testing time of war may present.

Regional reorganization, whether in London or elsewhere, is not necessarily a political question in the party system at all. There is little reason to believe that any political party would gain or lose much by the introduction of reform and, in the main, all are in favour of administrative efficiency as they understand it.

If, however, on political grounds reconstruction is not likely to meet real difficulties, strong opposition may be encountered from the numerous local authorities whose prestige or even existence might be affected. Dr. Robson directs attention to the importance of this appearance of vested interests in local government and to the need for investigation by competent sociologists. There is an obvious need for impartial scientific investigation. The picture of muddle and frustration which Dr. Robson draws is far from being a matter of local concern. The organization of London's government is a national question calling for national leadership and direction. Solution of the problem on such scientific lines as suggested by Dr. Robson would, moreover, have effects reaching far outside the boundaries of even Greater London. Not merely would a great impetus be given to regionalism, but also experience would be forthcoming which would contribute immensely to the wise planning of national resources and the effective handling of the intricate issues involved in the national planning of transport, the utilization of land and the preservation of amenities.

What is clear is that the whole question still offers a wide field for investigation or research. Municipal research is in fact largely unknown in Great Britain, and most municipalities are content to carry out their own investigations independently of the experience or practice of others. There is no information service available for municipalities to promote co-operation in the study of problems of municipal administration, and there are few signs of any desire for such co-operation. The recommendation in the report on the location of industry issued by Political and Economic Planning (P E P) for the establishment of a central information service on industrial siting (see NATURE, 143, 770 ; 1939) is essentially a step in this direction, but much more definite study and investigation are required. Regional problems require separate study, and above all study inspired by the belief that regions are not congeries of local units. The need for comprehensive improvement must be admitted, and the investigations prompted by a broader view and higher statesmanship. Only in such a spirit can we hope for effective experimentation with plans for federal or dual metropolitan government, and acquire the basic experience or use it wisely.

When all allowance has been made, however, for the need for fuller investigation on particular issues, it cannot be denied that there is already available an immense amount of knowledge which, if pooled and really utilized, would permit a much more effective co-ordination of national and local resources. The urgent necessity for economy in both local and national administration is a further reason for action. Unless some real attempt is made in London and elsewhere to find a regional solution on scientific lines for these interlocked problems of the chains of towns for which Patrick Geddes introduced the term 'conurbation', so far from the resources of the nation being husbanded and expended to the best advantage, we are likely to see yet further waste and frustration, through short-sighted economy starving essential services and neglecting bold and far-reaching measures which would eliminate the meaningless rivalries, overlapping and duplication so often encountered at present.

To secure action it is not enough to have an adequate plan and programme. Equally essential is a public opinion among the electorate alive to the possibilities and determined on reform. Unfortunately, as Prof. H. A. Mess pointed out a year ago in an able article in the *Political Quarterly* (9, 389 ; 1938), there are factors tending to weaken civic consciousness, and new cohesive devices and new forms of government may be required to develop civic consciousness in, for example, Greater London. At the best, in a new town there is a considerable time-lag before consciousness and sentiment adapt themselves to the new situation, and still longer before there is a change in local government.

This matter of local sentiment and public opinion is not entirely a matter of education. The term 'local sentiment' is ill-defined and often absurd. It would be hard to answer such questions as in whose minds it is found, how widely it is diffused, how strong it is and in what kind of attitudes and actions it results. The analysis by sociologists of such questions as these and others involved in the rise and decay of towns should be as valuable to those faced with the practical problems of administration as to those concerned with the education of the electorate in citizenship.

From whichever side we approach such problems, whether from that of education, the investigations which lead up to the planning, or the technical aspects and administrative detail of the planning itself, the responsibilities and opportunities of scientific workers are unmistakable. If we are to build, with resources impaired if not crippled by the sacrifices and vicissitudes of wartime, a social order in which the advantages which modern science has put at our disposal are more freely and fully utilized, and the present obstacles to that utilization or the forces dissipating our resources have been eliminated, scientific workers must play a major part. No defeatist spirit can be tolerated. Only as men and women, whether scientific workers or not, address themselves hopefully and adventurously to this creative task, ready to seize whatever opportunities may come and resolved that no inherited prejudices or vested interests of administration or property shall be allowed to injure the common welfare, can we hope to build cities and communities which will enjoy the true abundance which might be ours. We must be planning for that future even in the stress of war, if we are to be ready when the opportunity comes to transmute our dreams and visions into the cities, workshops and homes of a new era of civilization.

FUTURE OF ZOOLOGY IN INDIA

A LONG series of volumes, bearing the title of "The Fauna of British India", has been published under the authority of the Secretary of State for India, with the object of ensuring that the rich fauna of that great continental area is made properly known and, at the same time, of providing authoritative means for its identification. While its inception is more than fifty years old, the wisdom in launching this project has become increasingly justified in recent years. The first volume, which dealt with part of the Mammalia, appeared in 1888. The latest volume, also dealing with Mammalia, was issued in 1939 and is reviewed on the next page. Throughout this period, one or more volumes have been issued almost every year. During the War of 1914–1918, five volumes were published.

The "Fauna of India" has become increasingly used in Indian universities, colleges and museums. Furthermore, certain of the volumes rank as essential tools in the work of the scientific staffs of those Government departments concerned with agriculture, fisheries, forestry and tropical medicine; and indeed, certain forthcoming volumes promise to be of special importance in this respect. The "Fauna" series aims at providing accurate descriptions of all species of Indian animals and, thereby, forms the basis upon which further study depends. The importance of accurate identification scarcely needs stressing, whether it be, for example, of a mosquito concerned with disease transmission, an insect devouring a crop or an animal of solely scientific interest.

This primary object of the "Fauna" is being gradually achieved, but there is still a long and uphill road to traverse. For one thing, some of the earlier volumes are now out of date and need revision in the light of increased knowledge. Many divisions of the animal kingdom have not yet been dealt with, and there is the added difficulty of finding competent specialists willing to undertake the monographing of certain important groups. The Termites are a case in point, as they rank among the most destructive of Indian insects; little progress is being made in their study, mainly owing to difficulties attending their identification.

We learn with regret that the Secretary of State for India has decided to cease publication of the "Fauna of British India" for the duration of the War. While recognizing the present necessity for economy, it needs emphasizing that much of zoological progress in India may become involved in this decision. It behoves those who have such progress at heart to combine their efforts and do all that is possible to discourage any policy directed towards further economy, possibly resulting in the cessation of the publication of the "Fauna of India" altogether. Such an outcome would, in the long run, heavily counterbalance any monetary savings achieved.

The projected dominion status for India is linked with the growing part being played by Indians in the scientific development of their country. In this latter connexion they need every help that we can provide. From the zoological point of view, the least we can do is to ensure the continuance of this long-established publication.

THE MAMMALS OF INDIA

The Fauna of British India, including Ceylon and Burma

Edited by Lt.-Col. R. B. S. Sewell. (Published under the Patronage of the Secretary of State for India.) Mammalia. Vol. I: Primates and Carnivora (in part), Families, Felidae and Viverridae. By R. I. Pocock. Pp. xxxiii+464+31 plates. (London: Taylor and Francis, Ltd., 1939.) 30*s*.

BLANDFORD'S "Mammals of British India", published in 1888 and 1891, has until now been the standard work on the subject, and useful as that has been, it had for some years been regarded by zoologists as out of date, since a vast amount of additional knowledge on the subject has been gained in the last half century. A new edition that would embody the latest views on classification and the experience of sportsmen and travellers was greatly needed, and in 1923 Mr. Pocock, an eminent authority on the mammals of the world, undertook the task, little realizing the length of time that would be required owing to the vast amount of material to be handled and examined and the extent to which names of species and races required revision.

Formerly species were recognized mostly by their external appearance and local races regarded merely as varieties, whereas now careful measurements of the skulls and, where possible, other parts as well, has to be carried out. Well-defined local races are distinguished by the trinomial method of nomenclature.

That the work has been done with the utmost pains and thoroughness is clear from a perusal of the present volume, which deals with the orders Primates and Carnivora (in part). Of the former, British India possesses two species of gibbon, *Hylobates hoolock* and *H. lar*, these being the only representatives of the man-like apes, though the more ordinary types of monkeys are well represented by the macaques and langurs or leaf monkeys and the lemurs by the lorises.

Of the monkeys proper the author recognizes three distinct races of the rhesus in British India, the typical race occurring throughout nearly the whole of northern India and to a great extent Burma as well. This, the best known of all the monkeys as it is largely imported alive into European countries, although not regarded by the Hindus as sacred, is nevertheless left unmolested and so has become a very familiar object in native villages.

The lion-tailed macaque, also known as the wanderoo monkey, is certainly the most striking in appearance on account of the large growth of grey hair surrounding the face and the glossy black hair of the remainder of the body, but it is rare and keeps strictly to the thick forests of the Western Ghats.

Of the small lemurs, or lemuroids, the slow and slender lorises are well known, but research has shown that of the former there are no fewer than four and of the latter six distinct races. All are strictly nocturnal, sleeping bunched up in the fork of a tree by day, when they have much the appearance of the little spotted owl (*Athene brama*) and "the same habit of swaying the head and, when fighting, utter a similar screech". At the approach of darkness they creep forth and capture their prey "after a stealthy approach, with a lightning grab of both hands, and hold it in a tenacious grip while devouring it."

The greater part of this volume deals with the Carnivora, in which the author admits that classification is difficult. Of the Felidæ the zoologists of old grouped all in the genus *Felis*, with the one exception of the cheetah or hunting leopard which was distinguished by its so-called non-retractile claws; but Mr. Pocock finds that this animal is actually more nearly allied to the ordinary cats than the latter are to the lions, tigers and their near relations. He places the great cats (lions, tigers, etc.) in a separate subfamily, Pantherinæ, the more ordinary cats in that of Felinæ, including a number of genera, while the hunting leopard alone occupies the subfamily Acinonychinæ.

The lion was formerly abundant in northern India; but is now nearly extinct there, the few that remain being restricted to the Gir Forest in Kathiawar, where they are protected. The author believes that it made its way into India through Persia and Baluchistan in comparatively recent times and was not there long enough to penetrate far southwards. Its near extermination has been brought about by human persecution and not, as has often been suggested, by competition with the tiger.

This volume will surely rank as a very worthy member of a fine series.

D. SETH-SMITH.

GREY OWL: NATURALIST

Half-Breed
The Story of Grey Owl (Wa-Sha-Quon-Asin). By Lovat Dickson. Pp. xii + 346 + 12 plates. (London: Peter Davies, Ltd., 1939.) 10*s*. 6*d*. net.

"Grey Owl went to his last resting place as he would have wished. . . . As the sun set on Lake Ajawaan, the burial party turned back to town, one hundred miles distant, leaving Grey Owl among the birches and pines he so much loved, at peace in a remote and lovely grave."

THAT was in 1938, and thus was marked the end, at the early age of fifty years, of one of the most intriguing personalities that graced modern times. But it also marked the beginning of a rumpus which raged for some considerable time after his death. Grey Owl or Wa-Sha-Quon-Asin, a self-styled North American Indian, was shown to have lived his younger days in Hastings and attended the Grammar School there. His name was Archie Belaney, and his aunts still live in that town. Had he hoaxed the world, or was there a conundrum demanding thorough investigation? Mr. Lovat Dickson, Grey Owl's friend and confidant, spared no pains in his endeavour to establish the truth. But it seems that the whole truth may never be told. That he was not a full-blooded Indian of the Ojibway tribe is now certain; but that he was a pure 'white' is uncertain. It depends upon the origin of his mother, which so far has not been thoroughly traced. But after carefully examining the details meticulously recorded by his biographer, it seems impossible not to believe that he was a half-breed. For if he was not, then much of his behaviour, and indeed his very physical appearance, are incomprehensible.

Interest in that aspect of Grey Owl has naturally died down somewhat, but Mr. Lovat Dickson's book will arouse afresh and with even greater vigour interest in Grey Owl as a human personality and especially as a naturalist. During the present time of increasing interest in the teaching of biology and natural history, the book will prove of inestimable value for the inspiration that Grey Owl has given; for he was no mere sentimentalist where animal life was concerned. True, he loved animals, and in loving them learned *how* to study them, for, as one great zoologist once quoted in parody:

"He studieth best who loveth best,
All things both great and small."

"Here [at Ajawaan] he will live out his days, knowing only these animals and birds that he loves and who love him, sharing in their joys and sorrows, their triumphs and disappointments: watching them mate and sharing their parental triumphs; guarding them as best he can from Death, the only intruder who can do them harm." This is surely field natural history at its best: doubtless an unattainable ideal for most of us who have to live and study in less rural or less congenial surroundings, but at the same time an inspiration to achieve the best methods possible. In schools and colleges, much can be done by keeping and studying animals in captivity. Grey Owl's methods can be adapted to such less ideal conditions, so that the aquatic animals in the aquarium, the frogs in the frog pond, and the rabbits in their run receive the consideration which is their due. Love of Nature will naturally follow (if it is not already there), and just as Grey Owl, through the influence of his wife Anahereo, became converted from a killer to a conservator of wild life, so will students of natural history and biology become imbued with the desire not only to learn but also to preserve. It will not be necessary then to teach students, for example, that when gathering material for study only the minimum should be taken, and when they intend to study twigs in winter or summer they should never take even one twig from a sapling, thus disfiguring the tree for life. A host of ideas for field work, too, can be culled from this study of Grey Owl's life.

Even as a boy, Archie Belaney valued animals as living creatures, not as dead trophies. At Hastings he was allowed to keep his "friends", including snakes, frogs, birds, silk-worms, and rabbits, in a room at the top of the house. One is struck by the similarity between this boy and the boy Raymond Ditmars who kept his menagerie at the top of a house in New York. The former finally became a conservator of wild life under the Government of Canada; the latter is a curator in the New York Zoological Park and is still one of America's leading naturalists.

Through his very obvious desire to give a faithful biography of this truly wonderful man, Mr. Lovat Dickson may not even realize himself how much Grey Owl's love of Nature as here recorded will prove a unique source of inspiration to many students of plant and animal life; and the tenacity and singleness of purpose of Grey Owl is an absorbing study in itself. In his younger days he showed not so much a stubborn impatience with stiff English life as a strict determination to achieve a purpose. He achieved more than his purpose. He learned that it was undignified as well as unwise to take more of the fruits of the earth than one needed. He also achieved a keen sense of values, for he himself wrote: "You still believe that man, as such, is pre-eminent, governs the Powers of Nature. So he does, to a large extent, in civilization, but not on the Frontier, until that Frontier has been removed." Later, of his adopted tribe, he said:

"Nature is to us a sanctuary. To the Indian all Nature is sacred. All things are in accord, all part of the one great plan, Creation. . . . Thus, the Indian attitude towards Nature. Thus his philosophy—that not only man but all living creatures of the forest have a right to live, to freedom, a right to be happy in their own way, a right to a place in the sun."

The book never lacks interest. For reasons already given it should be read by teachers of biology, natural history and psychology; all students of these subjects should read it, too, and we strongly recommend that it be given a place on the shelves of school libraries for the benefit of older pupils. Mr. Lovat Dickson's absorbing style transports the reader to the open tracks and great forests of Canada where the sough of the birches and pines can almost be heard, while it seems impossible never to have met Jelly Roll, McGinnis and McGinty and the other animal characters which antic and prattle their parts through the narrative.

This raises a point to which the reviewer would direct the attention of Mr. Lovat Dickson. The book as it stands will be read by, and surely satisfy, many who knew of, and appreciated, the work of Grey Owl; it should also command the attention of biologists and natural historians; but it is not suitable—indeed is not meant—for younger children. For example, Grey Owl's apparent views on marriage would not be compatible with those of the average 'civilized' white man. But Grey Owl obviously loved children as he did other animals. He came into contact with many thousands of young admirers throughout the world. He wrote for them, he lectured to them (only the fact that he refused not to mention the "controversial" subject of fox-hunting prevented him from broadcasting to them during one of his rare visits to Great Britain). A "Life of Grey Owl" suitable for younger children would be a source of inspiration to them—an example of nobility of character (too often left to more warlike heroes to set) and, more important, a leader in the most desirable way of studying life around them.

LANDMARKS IN NEUROLOGY

Selected Writings of Sir Charles Sherrington
A Testimonial presented by the Neurologists forming the Guarantors of the Journal *Brain*. Compiled and edited by D. Denny Brown. Pp. xiv + 532. (London: Hamish Hamilton Medical Books, 1939.) 25*s*. net.

NEUROLOGISTS will open this volume with the highest expectations and will not be disappointed. It is a testimonial to Sir Charles Sherrington made up of extracts from his writings and edited by a colleague who has been in close touch with all his later work. True, it would need an incredibly bad editor to spoil the effect of such remarkable material, but Dr. Denny Brown has been a very good editor indeed. By a careful choice of extracts and the use of occasional connecting passages he has made a series of chapters, each complete in itself and each dealing with a particular theme. Some of the chapters are mainly derived from early papers, for example, on the nerve roots, some from the work at Liverpool or at Oxford, but most of them contain extracts from several sources and show the development of the subject in Sherrington's hands as well as his final judgment on it. We see the detailed mapping of motor and sensory supply, followed by the classical analysis of reflex activity in the spinal animal. Several aspects of reflex co-ordination have chapters to themselves, and considerable space is naturally given to the discussion of reciprocal innervation. One chapter is derived from the paper with Grünbaum on the motor area of the brain, and the last two deal with more recent work on the intimate nature of excitation and inhibition and on the adjustment of muscular contraction. There has been no attempt to include many of the topics dealt with in the book which had such a decisive effect on the progress of neurology, the "Integrative Action of the Nervous System", for the present volume is designed as a companion and a supplement to it.

The editor has done his work so well that the reader very seldom realizes that he has done it at all; there are footnotes to show the composite sources but the chapters have all the freshness and distinction of the original papers, and there is no sense of discontinuity where one extract succeeds another. In his choice of material, too, Dr. Denny Brown deserves our thanks; though with him we may deplore various omissions, his selection covers all the major lines of Sherrington's researches, and is constantly reminding us of the wide range as well as the originality of his work.

Sherrington's primary business has been with the physiology of the nervous system, and this volume is primarily a record of his scientific achievements in that sphere. For many of its readers, however, it will be valued even more as the record of a personality, as a record of Sherrington's way of looking at things, of solving a problem and of writing of what he has done, as a study, in fact, of the behaviour of a remarkable individual, 'C. S. S.' All through the book there are examples of the acute observation which finds so much new meaning in a posture of a cat's hind limbs or a flick of its ear, and of the experimental skill with which a complex act is resolved into its simplest components. For it has been Sherrington's achievement to explain the integrative properties of the nervous system by the analysis of such finished products as standing or scratching. But these chapters reveal much more than the method of approach and the technical equipment of a celebrated neuro-physiologist; they show as well the characteristic outlook and characteristic style which lends a peculiar charm to Sherrington's prose and is essential to the complete picture. In the present volume there are abundant examples of the apt turn of phrase, the striking metaphors and sudden illuminating comparisons which enrich his sentences.

We could have wished for more: this, indeed, is our only disappointment, though Dr. Denny Brown is not to blame. We cannot, of course, have a single volume to illustrate the many qualities of one who inspires such high regard and warm affection in all his colleagues. We should have liked samples of his verse, of his reviews and historical or biographical writing to place beside the strictly scientific papers. In his preface, Dr. Denny Brown lists some of the extracts he would have liked to include. The list is tantalizing, though it does not diminish our gratitude to the editor for what he has done. The testimonial he has given us is worthy of the great man of science to whom it is addressed and will certainly induce the reader to sample 'C. S. S.' in his other moods.

E. D. A.

PROBABILITY AND ITS APPLICATIONS

Probability, Statistics and Truth

By Prof. Richard von Mises. Translated by J. Neyman, D. Sholl and E. Rabinowitsch. Pp. xvi + 324. (London, Edinburgh and Glasgow: William Hodge and Co., Ltd., 1939.) 12*s.* 6*d.* net.

THIS book is scarcely the philosophical treatise which its title may suggest. It is the written-up version of six lectures on probability and applications, as conceived from von Mises' special pragmatic and empirical point of view. The lectures, to each of which a chapter is devoted, are couched in popular and non-mathematical style, but have none of the faults of this style. The English translation is excellent.

Dr. von Mises is well known as a strong protagonist of the relative frequency theory of probability. Probability to him is the limit of relative frequency in an indefinitely continued sequence of trials, but the sequence must be random. Imagine a coin spun repeatedly; write 1 for heads, 0 for tails. Then, according to von Mises, if in n spins m 1's appear, the probability p of heads for this coin is the limit of m/n as n tends to infinity; but he postulates not only the existence of this limit, but also the important additional property, that if any infinite subsequence be lifted out of the parent sequence on the basis of position only, irrespective of whether 1 or 0 appears in that position, then that subsequence shall have the same limit p as before.

Much of the earlier part of the book develops in simple language this theory of random sequences, and compares and contrasts it with the classical theory of probability. The later chapters pass, rather more summarily, to such topics as the so-called 'law of large numbers', kinetic theory of gases, the quantum theory, statistics and causality and the principle of uncertainty. This is all interesting, and done with an original turn, but the mind of the reader keeps reverting, with sympathetic scepticism, to the original attempt to define randomness. How can the postulate of place selection be expressed in mathematical form? We may lay down particular subsequences, for example, those enumerated by the squares of the natural numbers, or by the prime numbers, and so on. These are special place selections, and even for them it will surely be necessary to prove that parent sequences admitting such place selection actually exist. The author assures us that A. H. Copeland and A. Wald have found satisfactory answers to such questions as these.

All the same, to the present reviewer, a von Mises sequence is merely a *sample* sequence, extended to infinity, for the coin or other object, and is only one of an aggregate of sample sequences characteristic of the object. A sample of what? There's the rub; we are brought back to the *a priori*. And why bar the door so strenuously to sequences other than the postulated random ones? Systematic sequences, for example, 010101 . . ., are imaginable, as well as sequences which, in respect of the same coin or object, may not have the same limit *p*. The desirable thing would be to deduce the sequences from *a priori* conditions, and to show that the exceptional ones, which we may, if we please, call non-random (though the concept of randomness becomes unnecessary), are of zero measure in the aggregate of possible sequences.

Such views, which are put forward here for what they are worth, are in no way intended to disparage the book, which is a most valuable addition, from any point of view, to the literature of statistics and probability. A. C. A.

DEVELOPMENT IN ETHIOPIA

Ethiopia
An Empire in the Making. By Ferdinando Quaranta. Pp. xx+120+23 plates. (London: P. S. King and Son, Ltd., 1939.) 7*s*. 6*d*. net.

WE have to go back to the days of Rome for the mode of development inaugurated by Italy in its new Empire of Ethiopia. It started with road-making, on which at one time 60,000 Italians were employed, and already more than 3,000 miles of macadamized highways have been built out of 7,000 miles planned. At the same time the Italian scientific societies were mobilized to collect and tabulate the facts relating to earth, air and water. Lake Tana is stated to be of little importance to the Nile floods. Alluvial gold was discovered and is now being worked, but there is no likelihood of rich reefs. Platinum seems possibly to be of more importance, and there was also discovered copper and iron ores, but no petroleum. The fauna and flora were surveyed in connexion with their adaptation to various altitudes and meteorological conditions.

Meantime, Castellani's wonderful health service of the war had been converted into a permanent organization for the country with a first-class research laboratory adapted to pathology and parasitology at Addis Ababa and hospitals in each of the four provinces which were created; about eight hundred qualified medical officers are employed. Surveying the collected facts, Italy granted twelve billion lire (£133 million) to be spread over some years for special development. Agricultural veterinary and forestry services were established with experimental stations in each province, these governed and manned by university-trained officers. In the civil administration we deduce that the method employed is an army to keep the peace, with specially trained civilians whose duty is mainly the development of the country. There is little information on the administration, but the education and health of the natives seem to be an especial care. Meantime large areas of land in the high plateaux were found derelict, much of it the former property of Ras Makonnen, and steps were taken to colonize it. Upwards of a thousand Italian families have been here settled, growing grain, coffee, cotton and a host of minor products. For some years this immigration may be almost indefinitely increased by the introduction of regular cultivation in place of the alternate clearing and fallowing of the land employed by the natives. To this end a commission is at work investigating titles to land so far as they exist.

The technique of the Italians throughout would seem to be that of a large business firm rather than the haphazard method usually adopted in British colonies, where development is in the first instance confined to what already exists, usually by the increased employment of the old methods. Scientific men are only called upon when some pest appears or there is a shortage of food, the basal facts required for their employ being still unknown. We can recall no instance where the State has boldly capitalized development and colonization, the great settlement hoped for in East Africa at the beginning of the century having degenerated into the formation of large ranches worked by native labour, a condition paralleled all the way south to the Cape. Here in Ethiopia, if success be ultimately achieved, may be seen the commencement of a planned "Dominion" rather than a "Colony", the successful result of which would be of profound world importance. J. S. G.

GEOLOGICAL RESEARCH IN CHINA

The Geology of China
By Prof. J. S. Lee. Pp. xv + 528. (London: Thomas Murby and Co., 1939.) 30*s*. net.

THE remarkable growth of geological knowledge concerning China commenced with the foundation of the National Geological Survey, under the able directorship of the late V. K. Ting, in 1915. Its unbroken series of publications appeared in 1920 and those of the Geological Society of China in 1922. The first volume of A. W. Grabau's "Stratigraphy of China" was issued in 1924, the second in 1928, but invaluable as this exhaustive compendium was for a time, it soon became out of date as new results were accumulated, mainly by Chinese geologists whom Ting and his associates had trained. As the years passed, contributions rapidly increased, for provincial surveys, universities and foreign authors of many nationalities added their quota to the literature.

A new summary was overdue and it has been admirably accomplished by Prof. J. S. Lee, himself a pioneer of the new movement. The book is not, as its title might indicate, a text-book of regional geology of the stereotyped kind: it is rather a collection of essays, planned on a common 'structural' basis, in which all the essential facts are incorporated and their significance exposed.

In the successive chapters of Part 1 the following topics are discussed: the natural physiographical units of China and adjoining territories; the rocks of its ancient floor; its marine transgressions with the succession of their sediments, their characteristic fossils and the chronology of their movements; the geotectonic aspects of the Cathaysian geosynclines and geanticlines, as well as the history of the east-west fold zones which interrupt them at regular intervals. Descriptions of certain types of shear-forms and of their influence upon the existing framework of eastern Asia follow. Studies such as these, continental in their scope, lead naturally to wider inquiries still, and Chapter viii contains an analysis of the facial traits of the earth as a whole, to which is added an exposition of the author's views on the origin of tectonic movements and marine transgressions in general. These, advanced in logical sequence and entering into controversial geodynamical problems, evade abridged treatment and are best considered as a whole. Certain notable conclusions, however, are briefly stated as follows:

> "All tendencies to shearing movement on the continents are to be reduced to two components: the one towards the equator and the other towards the west. The latter is more pronounced in, if not restricted to, the low latitudes" (p. 351).

This, as the author admits, "sounds strikingly Wegnerian". Again:

> "As a whole, then, the surface strain of the earth can be explained by an adequate increase of rotational speed" (p. 358); and
> "The data thus assembled, when correlated with the 'pulsations' of A. W. Grabau . . . seem to favour the conclusion that it is the continued contraction of the earth that has caused the increase of its rotational speed" (p. 364).

These forcible speculations add value to and widen the appeal of the work as a whole, which still remains the only available, concise review of geological research in China as it stands to-day. Prof. Lee has succeeded in the extremely difficult task of condensing into comparatively little space a great amount of widely scattered stratigraphical and structural information, without sacrificing a lucid continuity of style for the sake of brevity.

Part 2 contains two chapters only, one of which is devoted to the contentious problem of China's Pleistocene climate. The other is headed "Regional Stratigraphy", and in it the larger stratigraphical units of fifty-one separate areas, ranging from Jehol and the Inshan Range in the north to Kuangsi and Kuangtung in the south, from South Manchuria and Chekiang in the east to Kansu and Yunnan in the west, are tabulated in natural successions with short lithological details and lists of leading fossils. How far the omission of subdivisions, and in rare cases of even larger units, is justifiable on grounds of simplification is a matter of opinion, but such arbitrary classifications are rarely entirely satisfactory. This one would have been improved by explanations of the origin of the terms and by the insertion of co-ordinates of the localities mentioned. As extensive tracts in China still await survey, modifications of the lists may be anticipated in future editions.

Each chapter is followed by its own selected bibliography, which would have been more serviceable had numerical references been given in the text and index. Illustrations total ninety-three items, including maps, sections and half-tones.

Geologists concerned with the great problems of continental movement will peruse the book with advantage; for students of Asiatic geology, whether their work or only their inclination leads to the East, it is an indispensable guide.

J. COGGIN BROWN.

ELECTRONIC MUSIC

By Dr. L. E. C. Hughes,
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By electronic music is meant the electrical reproduction of musical tones through loudspeakers, the actuating currents either having a purely electrical origination, or, if arising from a musical source, depending essentially on electronic means for their control and amplification, thereby leaving the musical designer free to make experiments which are not limited by the necessity of making adequate acoustic power.

Representative Electronic Musical Instruments

Type	Name	Basic principle	Note operation	Special effects	Tone Registration
Novel	Thérémin	Beat oscillator	Hand-adjustment	Glissando, Tremolo, Stop-button	None
	Martenot	Beat oscillator and filters	Hand in ring Keyboard	Glissando, Tremolo Tremolo	Stop keys
	Trautonium	Neon relaxer with formants	Wire over plate	Glissando, Tremolo	Continuous stop knobs
	Novachord*	Valve oscillators with multivibrator division and filters	Keyboard (72 notes)	Mixed Tremolo, variable attack and decay	Dial stops, foot sustain
Piano	Miessner or Vierling	Hammer on strings E-s pick-up	Piano keyboard (88 notes)	Swell and filters	Stop keys
	Neo-Bechstein*	E-m pick-up		Swell	None
	Pianotron*	E-s pick-up		Volume control only	None
Organ	Orgatron*	Air-blown reeds, E-s pick-up	Manuals, pedals, swells, tremolos	—	Stop keys, pistons, and couplers
	Coupleux	Valve oscillators and filters		—	
	Hammond*	E-m generators, synthetic		Variable stops	
	Midgley*	E-s generators, synthetic		Variable stops	
	Electrone*	E-s generators, synthetic		Synthetic bells	

Instruments marked * are easily available in Great Britain and have been examined by the author. All instruments, except the Pianotron, have foot-swells; the organs, except the Hammond, have grand-swells also. In the Hammond, one stop only on each of the manuals and pedals can be drawn at a time. Specifications of organs can be varied over a wide range, according to requirements; the Hammond and the Novachord alone are mass-produced, and therefore invariable.
(E-m = electro-magnetic, E-s = electro-static)

The most comprehensive developments have taken place in the United States of America, where Benjamin F. Miessner and Laurens Hammond lead the patent and commercial fields, and Lee de Forest demonstrated an electronic organ, one valve for each note, so far back as 1915. Germany, France, and Great Britain have also made important individual contributions, and the literature of the subject grows apace. This article is a brief review of the important electronic instruments available in Great Britain. The accompanying table gives the characteristics of a representative selection of such machines, without attempting to be exhaustive, because of the rapid developments in this field and the repeated introduction of new types. Those with novelty value do not compete among themselves, like the pianos. There is certain competition among the organs, since they have all been highly developed to meet a common need. Comparisons are difficult, since one cannot get them in pairs for a proper trial, but probably the time is coming when a scientific assessment of their qualities is due, which would settle many contentions among organists. Technically speaking, no one is quite certain what organists really want.

There are three major aspects of the problem, commercial, scientific and artistic. The commercial drive incites people to want something new or to do something already satisfactory in a cheaper or simpler way, for example, reducing the cost and bulk of pipe-organs, a lighter substitute for bells, or more noise from the feeble harpsichord. The scientific urge is to do these things in a new way, producing perhaps novel effects which may or may not have an eventual commercial value. The artistic aim in supporting these endeavours is to obtain new methods of expression and to compose for them, since composition in orthodox modes seems to be declining. The usage of an instrument depends on whether it is commercially satisfactory at the price, and on the sales drive to satisfy a manufactured demand.

The instruments mentioned have had some circulation and demonstration. The Electrone has been well received in cinemas and by the British Broadcasting Corporation, while the Hammond* has become best known. In the few years that the latter has been available, about four hundred models have been sold in Great Britain as compared with some six thousand in the United States, the production being fifty to sixty a week. Of the other organs, the Orgatron was used at the last Eisteddfod, and the Midgley* has just been launched. The Pianotron has recently appeared, made both by Everett and Chappell, and meets the modern need of conservation of space combined with concert-grand tone and volume. The latest instrument, the Novachord (a Hammond product), is so entirely novel, except its ordinary keyboard, that it will keep musicians of all grades amused for a long time. It is the sort of machine from which any keyboard enthusiast can get something worth while; it does not demand the discipline of the piano or regular organ.

THE NOVACHORD

Of the instruments offering novelty value many have been described, using a great variety of physical effects for generating and synthesizing desired or new musical tones. Valve oscillators, either pre-set or beating, have frequently been employed; also blocked-out wave-forms, either sinusoidal, chopped, or obtained from recordings of high-grade musical instruments, on spinning disks, scanned by light falling into a photo-electric cell, have been used.

The Novachord uses valves entirely, and in a new way. It is the second musical machine put out commercially by Hammond, and we are told there are more to come. It cannot replace any existing instrument, although it can imitate passably many familiar timbres. It has a 6-octave keyboard, above which is a row of stop-lever controls; for the feet there is a swell pedal, a duplicated sustaining pedal, and a bass sustaining pedal. The omission of the pedal clavier is a good selling point for non-organists. The keyboard manuals are not strictly percussive, as in a piano, but by setting the controls for a long build-up time, a very effective percussive touch is obtained, permitting, for example, a legato violin solo with a light harp-like accompaniment, passing through each other, if desired, on the one keyboard. The pedal sustains the weaker notes, without altering their loudness level.

The tones are obtained from twelve oscillators, the frequencies of which correspond to the top chromatic octave, the highest fundamental frequency being $E = 2637{\cdot}0$ ($A = 440$). The remaining fundamentals are derived from these twelve frequencies by division, one half in each of the five stages, each in a multivibrator dividing circuit, rather like those in television scanning circuits. Each fundamental has a control valve in which the output wave-form is adjusted, together with its attack and decay. The 72 notes, therefore, require 144 valves; some channel-amplifiers and power-packs bring the normal total to 159, double-triodes and small pentodes forming the majority. It is claimed that all valves, except the output stages, are lightly loaded and that the valve hazard is greatly diminished. The scheme for frequency-division seems logical, since the top frequencies cannot require much harmonic development; also the tuning operation on the top notes makes for precision over the whole range. Tuning is effected by adjusting the oscillators until one of the divided frequencies beats a known frequency with a known harmonic of the rectified mains.

The basic qualities of the Novachord are in the great range between percussive and singing, and in the adjustable attack. The tone-controls and filters, all adjustable over a wide range, are to some extent what one might expect, leading from a full diapason, reminiscent of a cathedral when fully delayed, to a thin reedy wood-wind of considerable power. Brassy and delicate tones are available, and the string tones are better than have been previously heard on a non-string instrument. A guitar effect is easily obtained, but, what is more interesting, good imitations of clavichord and harpsichord can be found, with, of course, ample volume; such possibilities may help to revive the interest in the older keyboard music, especially in public, which must have waned to some extent because of the lack of acoustic power and the difficulty of the cramped keyboards in authentic models.

A new feature in electronic music is not so much that three degrees of tremolo are here available, but that there are also six different rates, distributed in the twelve oscillators. The result is a delicate shimmer rather than the usual throb or wobble, recalling *tutti* violins; perhaps this is an effect organists are seeking; they never seem certain whether they require amplitude or frequency modulation, or both.

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* Descriptions of the Hammond and the Midgley organs appear in a paper recently issued by the Institution of Electrical Engineers, to be printed later in the Institution's *Journal*, entitled "Electronic Musical Instruments and the Development of the Pipeless Organ", by G. T. Winch and A. M. Midgley.

In construction, the Novachord has novel features. The whole of the valve system, couplers, filters, etc., is built into an enormous chassis, which can be turned over for servicing; electrical connexions to the keyboard are taken through long springs, so that the valve system need not be made dead during adjustments.

Finally, it may be remarked that there is no synthesis of notes on an equi-tempered scale involving borrowed quasi-harmonics, as in some electronic organs. This may please regular organists, because the non-coincident harmonics of the notes of a chord beat against each other in the customary way, and are not resolved into a perfect series of overtones, which is apparently one of the things conservative organists do not like, however pure it may be declared to be. We refrain from attempting to define what a pure tone, in the musician's sense, is supposed to be.

NEW PIANOS

The difficulties of imitating a piano are great, the initial impulse and the dither being awkward from the electronic point of view. A negative time-constant of attack has been achieved in the Novachord and this may lead to a complete electronic piano. The electrical amplification of piano tones is of long standing, but the usage has been slight; the recent arrival of the Pianotron may change this.

It is an easy matter to apply either electromagnetic or electrostatic pick-ups to the strings of the piano, and to control the output currents in volume and tone; the mistake which seems to have been made is to try to get something new out of hitting a stretched string with a felt hammer. It is true that tone amplification permits less tension in lighter strings and the elimination of the sounding board, with consequent lighter frames and extremely long time of decay, due to reduced damping. In the Neo-Bechstein, the middle forty notes alone have double strings, the remainder are single. This results in a steel-string tone, substantially undamped when sustained, with great range of crescendo and diminuendo on the swell pedal. Supposing that one wants real steel-string tone, very great care is necessary to avoid considerable blur. This instrument uses electromagnetic pick-ups, one for each set of four strings, located near the ends of the strings remote from the hammer. In the Vierling Electrochord there are a number of pick-ups along the wire, so that some of the sustained overtones are not lost.

Whereas in the Neo-Bechstein the piano has been simplified, in the latest Pianotron, where only straight amplification with electrostatic pick-ups is attempted, it has been found that it is essential to take the greatest care in the construction of the complete small piano, otherwise defects in the tone production are magnified. The electrostatic pick-ups are merely adjusted screws, ranged on a shaped board, which can be fitted into any ordinary piano: screening to some extent is essential, but the scheme permits concert-grand volume in the smallest space at a very reasonable cost. Many novelties may come and go, but the attractions of the dynamics of the free felt hammer on trichords will remain for those who wish to attain to them.

PIPELESS ORGANS

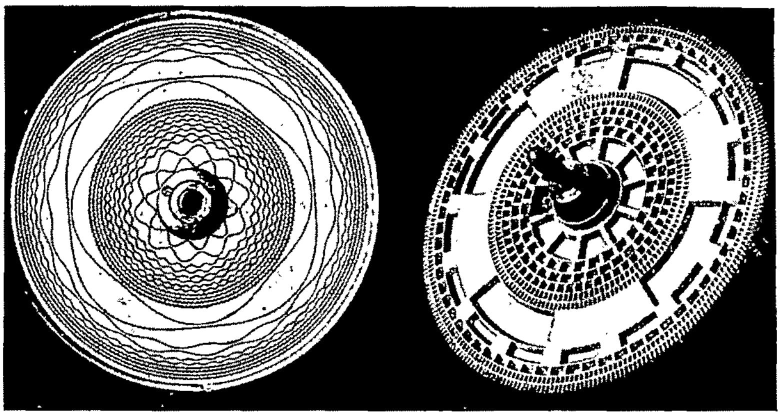
The dictionary definition of an organ must now be curtailed by the omission of any reference to pipes blown by air, for clearly an instrument which is played like an organ and sounds like an organ is certainly an organ, in spite of the purists. The wide variety of wave-forms obtainable from a valve oscillator has induced inventors to synthesize and control tones for organ purposes in diverse ways; the more recent successful instruments, however, do not use valves at all, except for amplification.

The Orgatron is most near a regular organ; indeed, it is a five-rank instrument, entirely pneumatically controlled, with air-blown free reeds, the motions of which are amplified through electrostatic screw pick-ups. The scheme is rather like that of the Pianotron, except that the polarizing voltages are not constant but are applied to the ranks as required by the stop keys. Fundamentally, when a key is depressed, high-pressure air is passed into the tube mechanism and eventually allows low-pressure air to pass through all reeds brought in by the pneumatic action of the stops. The stops also charge the pick-up screws to pre-set potentials through resistance-capacity retarders (to obviate key clicks). The fluctuating potentials on the screws, arising from the motion of the reed and consequent change in capacitance, are applied rank by rank, all the rank screws being in parallel, to the relative amplifier, after which they are mixed by anode-coupling.

Thus there is no synthesis of tones in the electronic sense. The five ranks of reeds, of which there are 289 in all, are voiced and tuned by the usual manipulation of the languids, and fundamentally give celeste, melodia, diapason, viole, and a pedal tone. From these a good selection of registrations is possible, augmented by a synthetic oboe and quintadena. Actual tubular chimes can be operated by second touch on the great, and an echo-radiating unit helps with reverberation in damped surroundings. Tremolo arises from a motor-driven paddle in front of the loud-speakers.

In appearance, the Orgatron is similar to most other two-manual organ consoles.

The Hammond organ has previously been described in these pages (Nature, June 19, 1937, p. 1043), and was shown by Sir James Jeans recently at the Royal Institution. The original model has been brought into conformity with the requirements of the Royal College of Organists for non-secular purposes by curving and adding a few notes to the pedal clavier, by having independent swells for the two manuals, and replacing the manual stop keys by pistons. Readers will remember that tones are synthesized from 96 inductor generators on two shafts driven by a synchronous motor, a number of adjustable stops for experimentation being provided.



The Compton electro-static frequency generator.

Left, one of the stators, showing the electrified tracks between anti-phase sine-wave insulating ridges, the remaining spaces being earthed; right, the rotor, which scans all the tracks and couples the modulated potential to the grid of the amplifier via the ball-bearing contact at the end of the shaft.

Scientifically, the Electrone and the Midgley are very similar. Each uses electrostatic runners, the periodic change in capacitance modulating the potential steadily applied through a resistance. In the Electrone there are twelve generator units, corresponding to the lowest chromatic scale, driven by one continuous belt from a synchronous motor. In the generator unit the scanner is connected, together with the eleven others, to the grid of the first amplifying stage. The radial scanning blocks, one per wave-length, are embossed so as to oppose double sine-wave tracks with earthed separations.

It is evident that all the harmonics of a bass-note can be obtained from one unit, since there is no fundamental difficulty in cutting tracks of an increasing number of wave-lengths. The total number of tracks is, however, markedly reduced by borrowing. For example, on the natural scale the *G*-wheel has a speed 1·5 times that of the *C*-wheel, all the units being the same, except for speed. Therefore the 3rd harmonic of *C* coincides with the 2nd harmonic of *G*; so why not use the 2nd harmonic track on the *G*-wheel when the 3rd harmonic of the *C*-wheel is required, thus dispensing with the 3rd harmonic track on the *C*-wheel, and so on, yielding a great economy in tracks? The driving wheels, however, are so diametered that the fundamentals and the harmonic tracks are equi-tempered. This makes the *G*-wheel about 0·1 per cent slow on the *C*-wheel. The third (borrowed) harmonic of *C* is therefore a little out of tune, a fact which is easily noticed on a cathode-ray tube, but it is doubtful if any organist can have noticed it by ear. Again, when *C* and *G* are sounded together, either on the keys or as a synthetic stop, the third harmonic of *C* does exactly coincide with the second of *G*, since it is borrowed, the increased magnitude of the common frequency being provided for in the electrical circuits. This means that the beat which ought, on the equi-tempered scale, to be present between the third harmonic of *C* and the second harmonic of *G*, amounting to about 0·1 per cent of the nominal common frequency, is not there. This argument can be greatly extended, the absent beats between some harmonics being more pronounced than that above indicated. The Electrone compromises in that only the third harmonics are borrowed.

There is no doubt that the scheme works and the machine sounds very much like a regular organ, but is it this absence of beats among harmonics which prevents the more precious and conservative of organists from admitting that the Electrone is an adequate substitute, at a third the cost, for a regular pipe-organ? Can any ears be so sensitive in a live room?

The Midgley electronic organ functions in a very similar way, except that in the unit generator the dielectric alone rotates. The sine-wave areas on the stator electrodes oppose the blocks of the scanning dielectric as before. The notes are synthesized as required by the stops in the electrical circuits as before; registering a number of stops builds up the contributions, just as extra ranks of pipes are ordinarily brought into action. Corresponding in function to the draw-bars in the Hammond, sets of dials are provided for players to experiment with in using new stops or doubling existing stops.

It can be fairly claimed that these electronic organs function as intended, but whether one is superior to the others for a specified musical purpose is an open question and must await a proper series of trials, with adjudication by a representative body of musicians; meanwhile, those who have to pay for organs are deciding for themselves.

Accepting the musical adequacy of electronic organs, their use in churches has several artistic and technical advantages. The disposition of the sound radiators permits a fine unanimity of attack in congregational singing. Acoustical treatment to enable preachers to be heard need not spoil reverberation, which can be increased artificially to any degree desired. Finally, the great enemy of pipe-organs, cold weekdays and a warm Sunday, is rendered innocuous: electronic organs scarcely need tuning.

The craft of the organ tuner, with his mallet and cones, has started to pass; he is being replaced by an electrician, with no more equipment than is required for servicing a radio-set. There is one thing we can be certain of, no electronic organ ought to succeed unless it is finally voiced by a craftsman of tradition. If this is not insisted on, classical organ tone will not be known to the rising generation, brought up on secondhand and harsher music, and may be lost for ever.

APPLICATIONS OF PSYCHOLOGY IN WAR CONDITIONS

A SYMPOSIUM on some applications of psychology in war conditions was arranged by the Industrial Section of the British Psychological Society and held on January 25. The introductory paper was by Dr. May Smith, who gave an outline of the final report of the Health of Munition Workers Committee, published in 1918, and addressed to the Right Hon. Winston S. Churchill, M.P., then Minister of Munitions. The Committee included Sir George Newman, Sir Walter Fletcher, Sir Leonard Hill, representatives of the Home Office, members of Parliament, physiologists and pathologists. It had been appointed in September 1915 "to consider and advise on questions of industrial fatigue, hours of labour, and other matters affecting the personal health and efficiency of workers in munition factories and workshops".

At the beginning, the Committee was confronted with the width and complexity of its inquiry. The central and foremost problem was concerned with fatigue. Having realized that continuous human activity is associated with a gradually diminishing capacity, the Committee decided that the only direct test was that of output.

Views on the more theoretical aspects of fatigue were really immaterial, since it was known that the ordinary restrictions on hours of labour had been very widely relaxed, that Sunday labour previously forbidden for women and young persons and practically unknown for men, except for a few continuous processes, had become common. The employment of men for 70–90 hours a week was common, more than 90 hours was not infrequent, and there were even cases in excess of 100 hours. In short, there was a return to some of the worst conditions of the early nineteenth century.

The Committee used two methods of getting information: (1) it took evidence from people in direct contact with workers, (2) it initiated *ad hoc* investigations. The first method enabled it to get information at once, the other necessitated time.

On reading through the evidence, it is impossible not to be struck by the volume and pertinence of the findings. On the whole, the evidence showed that long hours imposed too severe a strain on the workers, with the result that the rate of production tended to decrease, sickness absence and broken time to increase. Evidence of the almost intolerable strain on the management was given. The full blast of the hours was not felt at first, because the increased pay resulted in better food.

Such evidence, while overwhelming in some cases, was, however, not quantitative, and witnesses differed widely as to what constituted reasonable limits; the Committee had to emphasize the almost complete absence of any scientific data.

The appointment of Dr. H. M. Vernon and others was intended to supply this deficiency. He showed by output figures that the 12-hour day was a costly and useless procedure, that the long hours simply defeated their own end. "The country cannot afford the extravagance of paying for work done during incapacity from fatigue just because so many hours have been spent upon it," reported the Committee.

Apart from hours, environmental conditions were realized as important, and ventilation emerged out of the hands of the engineers and passed to those of the physiologist, and under the ægis of Sir Leonard Hill there entered the katathermometer.

Lost time through sickness absence, lateness, broken periods, or just absence, soon became a formidable problem. The causes of lost time were classified into two main groups : (*a*) Causes mainly inherent ; for example, the employment of people of inferior physique, inadequate housing and transport facilities, wintry weather, darkened streets and inequalities of food supply, the domestic duties of married women, the war-preoccupation and exigencies of all workers, sickness and disease caused by conditions outside the factory. (*b*) Causes mainly controllable ; for example, fatigue, sickness and accidents of factory origin, insufficient wage incentive, faulty internal organization, indifference, slackness, laziness, discontent, prolonged hours, overtime, insufficient rest periods or holidays, and excessive consumption of alcoholic beverages.

The Committee came to the conclusion that the absence through sickness was considerably underestimated, and pointed out that if there is an undue proportion of sickness in any group of workers there is also likely to be lessened vigour and activity among those who are not away sick. It noted the absence of adequate records, partly due to difficulty in regard to medical certificates and partly because minor illnesses were not reported.

The section on incentives starts off, not with wages or bonuses, but with the statement that "the first incentive is the health and physical fitness of the worker", and although the Committee confined itself to the factory conditions contributing to that, yet the field covered is very wide. Only after this does the Committee discuss wages, which must be "well adjusted, equitable and clearly understood".

The Committee notes that "what is needed is not a cast-iron system of employment but a sympathetic or correct understanding of the physical and mental capacities of each worker and their most satisfactory and economical application".

The present War has introduced many of the conditions of the War of 1914–18, but already after four months there are signs of an interest not aroused until after thirteen months before ; happily we are better equipped now than in 1914.

Dr. Vernon took up the discussion, pointing out that excessive hours constitute a major problem when increased output is urgent. Many employers cannot grasp the fact that, after a certain number of hours of work, the worker is so fatigued that production falls. Some investigations undertaken during the War of 1914–18 showed that the actual gross output—not merely the average hourly output—is less on a 12-hour day than on a 10-hour. It is true that in the early stages of a war, patriotism plays a definite part in keeping up the output, and in the last War employers often defended the excessive hours on these grounds ; but Nature cannot be defied indefinitely and many men and women were in a chronic state of fatigue. For many processes in munition work, Dr. Vernon found that output is a very satisfactory measure of the effects of hours of work, since the same materials are being used and the same articles made, the only important variable being the number of hours worked. Sunday labour, except for emergencies, proved wholly unsatisfactory, in spite of the extra pay : it has been described as "8 days' pay for 7 days' work with 6 days' output".

The problems involved in night-shift work are not easy to solve, for, quite apart from the organization within the factory, there are complications connected with the domestic arrangements of the workers and transport.

With regard to the material environment, Dr. Bedford pointed out that there is now available considerably more scientific knowledge than in 1914. Numbers of researches have been made to find out the relationship of lighting, heating and ventilation conditions to efficiency, comfort, accidents, and health. The last twenty-five years have shown a pronounced tendency to have more light, not only for fine work but also in general : a good light is felt to be more cheerful. Working all day in artificial light gives people a feeling of being cheated ; if, however, owing to the nature of the work, this is inevitable, much can be done by the use of extended light services and by arranging artificial windows and similar devices.

Heating and ventilation cannot be kept separate. It used to be considered adequate if the air was pure and stimulating : now increased emphasis is laid on the need for an adequate degree of warmth as well. As with lighting, the standard of warmth has gone up ; many factories used to be below 50° F., whereas recently a research worker experienced difficulty in finding one below 55°. For the full assessment of thermal conditions a single yardstick, however, is impossible ; individual conditions have to be considered and weighed.

The recent 'black-out' regulations have added to the difficulties of factories relying on open windows, so that there are many complaints of stuffiness and overheating. Forms of light-traps, however can be devised, which allow of the entrance and exit of air while complying with the lighting regulations.

Dr. Millais Culpin said that since 1914 considerable progress has been made both in the diagnosis and treatment of psycho-neurotic illness. The last War took us unawares, with few doctors capable of treating such illness or even of recognizing its existence. Psychological casualties in the civilian population under direct war risk may be fewer than we might expect, for the civilian is allowed to show manifest fear or to run away. That some kinds of psychoneurotic people should retire to the West Country—as many did during 1914–18—is best for everybody. He regretted the use of a phrase now rather popular, namely, 'fright neurosis'. Fear is of biological significance, and to be afraid, even greatly afraid, is, in some conditions, a natural reaction. Pathological fear is in a very different category, the reaction being usually quite inadequate to the situation.

Nor is it right to class all psychoneurotics in one group; some of them can be diagnosed as likely to break down in peace or war, and some will not; others will withstand the most difficult conditions. Some who had managed to adjust themselves to the last War and to the years since have broken down now, suppressed memories of the last War being touched up. To confuse such cases with 'fright neurosis' is disastrous.

How civilians will behave in air raids is difficult to predict. It is possible that some with a high degree of claustrophobia will prefer to be bombed rather than have the feeling of being in an enclosed space; within a shelter some may faint, and others may adjust to the circumstances although feeling considerable discomfort. With regard to the question of what can be done with cases of uncontrolled behaviour or of those who faint in an air-raid shelter, Dr. Culpin said that the fainting neurotic might be left to himself, while harsh treatment might be needed for others. Two schools exist in the medical profession with regard to the treatment of the neurotic who has broken down: one is the school which would diagnose and treat by psychological means, and the other he called the 'kick in the pants' school. Fortunately for the world, the latter is found chiefly among the elderly, who are despised by the younger and more adequately trained doctors.

Mr. Alec Rodger, discussing the selection and grading of personnel, said that a great stimulus to this was provided by the Americans in the War of 1914–18. In order to sort out people fit for different kinds of training, nearly two million men were given intelligence tests. The experiment proved so successful that other countries, including Germany and the U.S.S.R., have adopted similar intelligence testing procedures. Mechanical aptitude tests have also been widely employed. Both intelligence and mechanical aptitude tests and other psychological techniques are used to a limited extent in our own fighting Services.

The value of tests in the grading of personnel needs special emphasis. Many are accustomed to think of them only as instruments in the selection of men and overlook the fact that they can be used effectively in the grading process, the aim of which is to arrange that individuals of similar abilities are instructed together. Mr. Rodger added that, since intelligence tests had been used by many school and other authorities over a period of years, much data of value to the Services could probably be made available immediately.

CENTRAL REGISTER OF SPECIALISTS

(SECTION FOR SCIENTIFIC RESEARCH)

IN the issue of NATURE of April 8, 1939, p. 575, there was an account of the establishment by the Royal Society and the Ministry of Labour jointly of the Central Register of Specialists (Section for Scientific Research), with the main aim of providing a list of scientific workers whose professional services might be useful in time of war. It will be remembered that each scientific worker was asked to fill in a card giving an account of his qualifications and some details of his career. From the point of view of the Royal Society the register also had a secondary purpose, for, if there were not to be a war, then it was felt that this was a good opportunity to obtain a census of the scientific knowledge of the country which would be of general value. With the outbreak of war the main purpose of the register was called into play, even before its compilation was complete, and it will be of interest to give a short account of some of its consequent workings. This article only deals with the register of men of science, and does not touch on the similar work of the Ministry of Labour in other branches of learning or technology.

In the spring of 1939, cards were sent out to men and women whose names had been furnished by certain learned societies. Up to the end of July a little short of eight thousand had been sent out and some five thousand replies received. Since July, several hundred more have been sent out to people who had been missed in the earlier lists, and the total number of cards returned is now more than six thousand. This list is largely composed of names from universities, from industries and from the research associations. Men already in the Government service have also been permitted to send in their cards, so that they are included in the census; though of course their services are already at the disposal of the Government, so that for them the more immediate function of the register does not arise. The committee of men of science which is helping to work the register is subdivided into panels composed of experts in each subject, and during the summer the panels met to sort out and classify their cards. There are, of course, great differences in the characters of the various subjects, and there was great uncertainty in the natures of the expected demands, and so no uniformity was attempted in the practice of the different panels. For example, the engineers and physicists subdivided their list into quite small groups, whereas in mathematics it was inappropriate to do this because, apart from the leading experts in each branch whose names would be well known, general mathematical skill is easily transferable from one subject to another.

On the outbreak of the War, the register immediately began to function. A certain number of leading men of science had already been earmarked for service directly, so that it was for junior posts that the register was specially useful. Recourse to the register is now the normal procedure for filling all scientific posts in the Government service when these are of the standard of the register. The way the register operates is usually somewhat as follows. The Government department requiring staff presents a written demand to the register for the staff that is needed in order to fill a certain number of posts, stating the nature of work, the qualifications required and the salary offered. A preliminary selection from the cards in the register is made by the staff of the Ministry of Labour with the advice and assistance of the expert panels, and often of technical representatives of the departments. The selection is then submitted to the appropriate panel so that the selections can be considered, and if necessary discussed with a technical representative of the ordering department. In this way the quality of the man needed can be more accurately assessed. When a final selection has been made, the men selected are circularized and are asked whether they are willing to be considered for the post offered provided that their employers are willing to release them. Thus the department concerned receives from the register what is practically a short list of suitable candidates who are known to be willing to take the post offered. The department then itself arranges for interviews and makes the appointments, and the Ministry of Labour takes no further part in the proceedings, except to record appointments.

It may be appropriate here to refer to a matter which has received some attention though it is not directly connected with the register. In many laboratories a number of men are doing co-operative research, and it was felt that the operation of the register, which deals with individuals, might seriously endanger such work by taking away some members, possibly even though they might be only minor members, of such teams. The question of safeguarding scientific teams was entrusted to the Department of Scientific and Industrial Research. The matter proved by no means easy, because a team is a very indefinite thing. For example, in one university a laboratory might with equal justice be regarded as either one or several teams, while in another, with quite as good a scientific record, the work of the members would be so independent that it would hamper their usefulness to call them a team at all. In the end it was settled that (with one or two special exceptions) there were to be no teams in universities, since if the operation of the register was in danger of spoiling important team work it would be easy for the university or the head of a department to make (as 'employer') representations to that effect. On the other hand, there was danger that the production of industry might be seriously hampered by draining away the members of its research teams, and so the research laboratories of a number of firms have been registered as teams. Their members cannot be called on through the machinery of the register without consultation with the Department of Scientific and Industrial Research.

The register has now been working for more than four months and it is possible to review some of its results. It appears that it has well justified the effort put into its preparation. For the most important appointments it was of course scarcely necessary, as the likely candidates for such appointments would be familiar to any adviser, but for other appointments it has been most useful, so that wherever a need has arisen in the Services, names could be put forward to meet it. In some of the subjects the demand has exceeded the supply, but there are a good many where the opposite is the case. As might be expected, the biological subjects are not in great demand for matters connected with the Services, and few new outlets for them are apparent in agriculture or industry; it looks unlikely that, for example, there will ever be calls for more than a limited number of zoologists or botanists as such. On the other hand, certain categories have become practically exhausted of scientific men. The question of training people for rare categories is being examined, and persons with 'secondary' qualifications in them are used when possible.

Consideration has been given to the point that it is now possible to say that a good many of those on the register who are reserved under the Schedule of Reserved Occupations will probably never be called on to use their professional knowledge for war purposes in a civil capacity, and the possibility has been examined of notifying them that they are released from their reservation. It was felt that it would be very invidious to take the initiative in this, but machinery has been set going to arrange for the possibility of release. It will be open to any scientific man reserved under the Schedule to apply for release, and his case will be considered by the appropriate panel. In arriving at its decision, the panel will give consideration to any representation by the applicant's employer (university, firm, etc.), and to the possibility that the applicant's professional services might be needed later, even though the demand is not yet apparent. In view of the differences of demand in the various scientific subjects, each panel is adopting its own policy, but broadly speaking the general policy will be that release will be granted to anyone who is unemployed or likely to become so, while for others the grant will only be made after much more careful consideration of each application.

OBITUARIES

Sir Francis Goodenough, C.B.E.

SIR FRANCIS GOODENOUGH died on January 11, after a long period of ill-health, at the age of sixty-seven. It is possible to surmise that had he come under the influence of a science master at an impressionable age, as has happened to many of us, he would have made a career in some branch of science which would have gained a great leader. As it was he performed what is perhaps the more difficult feat, namely, the introduction of some measure of planning and science into commerce.

He lived to see the subject of management adorned by the adjective 'scientific' and to participate in international congresses under the double heading. He was one of the first and greatest salesmen in the gas industry, where he emphasized the importance of supplying a service as well as a commodity. Equally valuable were his services in the cause of education applied to gas engineers and gas salesmen. Here he insisted that the scheme, elaborated in conjunction with the City and Guilds of London Institute, should be one of education as distinct from examination only. It is known that the early difficulties in connexion with this were almost overwhelming, and that but for his patience it would have been difficult to overcome them.

Sir Francis was a pioneer of co-operative advertising and a leader of many other co-operative movements both within and without the gas industry. A man of rare vision and large ideas, faculties usually involving impatience, he was characterized by an easy and genial manner and the quality of complete sincerity. In addition to his successful career with the Gas Light and Coke Company, which he saw rise from something very much smaller to its present outstanding position, he was always visualizing developments ahead of the time.

Sir Francis was one of those who will probably appear greater in retrospect than he does at the time of his activities, when personalities and policies hold the stage. Science and commerce lie perhaps on opposite sides of the river of daily endeavour, but many bridges are being built across the river, over which traffic struggles in either direction. One such bridge builder was Goodenough; the edifice he has erected, built on sound foundations, will stand the stresses of stream and wind and the increasing load of progress for many years to come. E. F. ARMSTRONG.

Miss E. K. Pearce

MISS ETHEL KATHERINE PEARCE, whose death occurred on January 8, at Morden, Dorset, at the age of eighty-three, was an entomologist who devoted her energy and enthusiasm almost entirely to Diptera. A daughter of a vicar of Morden, she had around her one of the finest entomological hunting grounds even in a county as favoured as Dorset. The first series of her work, "Typical Flies", a photographic atlas in which the author sought to popularize and extend the study of an order of insects much neglected in those days, was published in 1915. A preface giving practical guidance for collecting and preservation is followed by a sketch of Brauer's classification of the Diptera, and his sixty families are named, the Aphaniptera (fleas) being included. The forty-five pages of reproductions from photographs, considering the great difficulty of such work, are admirable, the flies figured being all recognizable and characteristic. In some cases preliminary stages are shown. The photographs of typical Dorset localities are a very pleasing and helpful feature. They not only give information as to the habitat of the fly, but also tempt the Nature lover to explore such delightful environment.

The flies taken as types of the various families were chosen with the help of the late Prof. Theobald, F. C. Adams, and other capable authorities, with great care. A second series appeared with 125 photographs in 1921, and a third series with 162 photographs in 1928. In all, fifty-five out of the sixty families of flies enumerated by Brauer are represented in the three series by a type fly. The brief biological notes given under the figures add much to the interest of the book. The author was helped, too, in her work by her brother, Mr. N. D. R. Pearce.

Amiable and benevolent, and ever keen on doing useful work, Miss Pearce's death leaves the ranks of entomology the poorer. Her contribution cannot fail to aid beginners in classifying and identifying the flies they find. Non-specialists, also, who wish to place any fly they see in its systematic position, will likewise find Miss Pearce's guide a boon.

F. H. HAINES.

WE regret to announce the following deaths:

Prof. Aristide Busi, director of the Institute of Medical Radiology, Rome, aged sixty-five years.

Mr. W. M. Gardner, principal of Bradford Technical College during 1905–21, on December 22, aged seventy-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. Ugo Mondello, the well-known seismologist, formerly director of the Ardenza Observatory, Italy, on December 3, aged sixty-one years.

Prof. S. Lees, Chance professor of mechanical engineering in the University of Birmingham, aged fifty-four years.

Mr. B. D. Porritt, director of research of the Research Association of Rubber Manufacturers, on January 28, aged fifty-six years.

Mr. F. T. Shutt, C.B.E., formerly Chief Dominion Chemist and assistant director of the Central Experimental Farm, aged eighty years.

Prof. C. A. Strong, formerly professor of psychology in Columbia University, aged seventy-six years.

NEWS AND VIEWS

Scientific Collaboration between Britain and France

A DELEGATION from the Centre National de la Recherche Scientifique, led by its director, Prof. H. Longchambon, has been visiting Great Britain during the past week. The other members of the delegation were: Prof. M. Fréchet, professor of mathematics at the Sorbonne; Prof. G. Darmois, professor of mathematics at the Sorbonne; Prof. F. Joliot, professor of physics at the Sorbonne; Prof. P. Auger, professor of physical chemistry at the Sorbonne; Prof. C. Sadron, professor of building legislation at the Ecole Nationale Supérieure des Beaux-Arts, Strasbourg; Prof. G. Dupont, professor of theoretical chemistry at the Sorbonne; Prof. Denivelle, professor of chemistry at the Ecole Supérieure de Chimie at Mulhouse; Prof. A. Mayer, professor of medicine at the Collège de France; Prof. L. Blaringhem, professor of botany at the Sorbonne; Prof. P. Chouard, professor of agriculture at the Conservatoire National des Arts et Métiers; Prof. P. Langevin, professor of experimental physics at the Collège de France; Dr. P. Montel, professor of mathematics at the Sorbonne. This, it may be presumed, is one of the measures referred to by Lord Chatfield when he spoke recently in the House of Lords on the exchange of information and extension of the liaison between the scientific organizations of Great Britain and France (see NATURE, Jan. 27, p. 142).

The programme arranged for the visitors included a reception at the Royal Society on January 29, when the guests were received by Sir Albert Seward and Prof. F. G. Donnan on behalf of the Royal Society. Dr. E. V. Appleton then addressed the meeting, and described the organization of the scientific effort for defence in Great Britain. The French delegation was introduced by Dr. Montel, after which Prof. Longchambon described the steps taken in France to mobilize scientific research for the country's war effort. Prof. Langevin also spoke. On January 30, the French delegation visited the National Physical Laboratory at Teddington, and on the following day travelled to Cambridge, where they saw the Cavendish Laboratory (Prof. W. L. Bragg) and the Colloid Science Laboratory (Prof. E. K. Rideal). A meeting of the Royal Society was arranged for February 1, at which Sir Arthur Eddington was reading a paper on "The Masses of the Proton, Neutron, and Mesotron", and L. Jánossy and B. Rossi a paper on "Photon Component of Cosmic Radiation". Prof. E. J. Williams was giving an account of his experiments on the transformation of mesotrons into electrons (see NATURE, Jan. 20, p. 102), and Prof. P. Auger and Prof. P. M. S. Blackett were taking part in the discussion. On the same evening the French delegation were being entertained to dinner by British men of science.

Scientific Research for the Services

THE Advisory Council of Scientific Research and Technical Development (see NATURE, December 30, 1939, p. 1085) held its first meeting at the Ministry of Supply on January 25. Colonel J. J. Llewellin, in the absence of the Minister of Supply through illness, pointed out the Ministry has numerous establishments for research and development, etc., which, in some directions, work for all three Services: these establishments are supplemented by work in progress at various other research laboratories throughout the country. Lord Cadman, chairman of the Council, said that the research programme is most extensive, comprising more than a thousand items. The subjects being dealt with vary within very wide limits; it is therefore necessary to have an extensive and comprehensive scientific representation on the Council, which will function through a number of committees, on which other men of science will be invited to serve. So far, the committees formed deal with metallurgy, general physics, ballistics, structural engineering, communications, etc. The Directorate of Scientific Research of the Ministry of Supply already has a permanent staff of about nine hundred, but it is satisfactory to know that the Council also proposes to enlist the aid of independent outside men of science if, and when, required.

Institution of Electrical Engineers: Faraday Medal

DR. ALEXANDER RUSSELL has been awarded the eighteenth Faraday Medal by the Council of the Institution of Electrical Engineers. The medal is awarded for notable achievement in, or help to, electrical science or industry, and Dr. Russell is qualified in both respects. His works on alternating currents and the theory of cables have long been classical; not less well known are his researches on the sphere gap, and many other mathematical researches and papers communicated to the learned societies. He recently published the "Life of Lord Kelvin", whom he knew in the early days. Dr. Russell has been connected with Faraday House from its inception in 1889, and became principal in 1909. During fifty years he has helped in, or been responsible for, the training of thousands of electrical engineers, now to be found all over the world. The outstanding feature of this education has been the encouragement of men to bear their own responsibilities; many of his students, both in the early days and recently, have achieved important work even during their student days. He has been for many years a valued contributor to NATURE.

Dr. Russell is a past president of the Institution of Electrical Engineers, of the Physical Society of London, and of the Junior Institution of Engineers. He was elected fellow of the Royal Society in 1924 and made an honorary member of the Institution of Electrical Engineers in 1937. Later in the same year he retired from the more active work at Faraday House and became advisory principal. He thus holds available for the College his life's experience, and maintains contact with the hundreds of old students who can call in to see him, and with the thousands who can only write. We like to think that it is this aspect of his life's work, and the army of valuable men that has resulted from it, that the Council of the Institution of Electrical Engineers had in mind, not less than his mathematical researches, when the award of this year's Faraday Medal was made.

Captain C. W. Hume

CAPTAIN C. W. HUME resigned from the editorship of the *Proceedings of the Physical Society* on January 1, after having been responsible for that journal for a period of twenty years. A member of the reserve of Army officers, he rejoined his unit some time previously, and continued his editorial work until impending changes made it no longer possible. During his tenure of the office, he had seldom missed a Council meeting, and was usually present at science meetings, to obtain a record of the discussion on papers at first hand. He took great pains with the preparation of the *Proceedings* to ensure that papers should be free from ambiguity and obscurity, and printed in uniform style. His other interests were many. He founded the University of London Animal Welfare Society and the Universities Federation for Animal Welfare, and had also taken an active part at one time in the Association of Scientific Workers and the Parliamentary Science Committee, as it then was.

African Studies and the War

NOTWITHSTANDING the War, native administration in Africa must be carried on; and the problems incidental thereto are likely to become more, rather than less, insistent in the world turmoil which now prevails. For the moment, indeed, paradoxical as it may seem, circumstances probably are more favourable to African studies directed to possibilities of future development than if the end of hostilities were within measurable distance. Such, at least, would appear to be the judgment of H.M. Secretary of State for the Colonies, at whose request Lord Hailey will shortly pay a visit to a number of the British dependencies in West, East, and Central Africa to undertake an informal study of certain aspects of native administration. This investigation will carry further the work on such questions which Lord Hailey has already done during his earlier visits, when collecting material for his "African Survey". His inquiries on this occasion, which are expected to take about six months, will be directed in the main to the comparative study of forms of native administration, with special reference to their technical working and their future development. It will be of more than passing interest to see how in the judgment of so experienced an observer as Lord Hailey the diversity of conditions which will be brought under notice justify, or the reverse, the standardization of administrative methods in the interests of native advancement, and how far a more intensive study of native institutions in relation to administration than they have yet received, is demanded.

At the close of his tour, Lord Hailey will spend a short time in Southern Rhodesia, where facilities will be afforded for an unofficial study for comparative purposes of the principles and methods of native administration followed there. This study, it is anticipated, will be of great value when further consideration is given to the difficult questions of native policy in the Rhodesias and Nyasaland, to which attention is directed in the Report of the Rhodesia–Nyasaland Royal Commission (see NATURE, 143, 829; 1939).

International Co-operation and African Studies

INTERNATIONAL co-operation, which in recent years has contributed so markedly to progress in African studies, is now necessarily much curtailed. Nevertheless, the International Institute of African Languages and Cultures, although its existence as an international institution seemed to be threatened, has decided that, so far as possible, its work must continue. In a communication over the signature of Lord Lugard, chairman of the Executive Council, which has been circulated to the members of the Institute, the reasons for the decision are given. Science, it is pointed out, is neutral, and further, the peoples of Africa, in war as much as in peace, need all that science can do to promote their welfare and advancement. "It seems to us important," says Lord Lugard, "that public interest in the welfare of the African peoples should not be 'blacked out' by a too exclusive concentration on events in Europe", adding "we are convinced that the Governments which have accepted responsibilities in Africa will not wish the war to put a stop to the various efforts at the social progress of its peoples, which they have initiated in years of peace." That this view is justified is borne out by the mission undertaken by Lord Hailey at the request of the Colonial Office, to which reference is made above. Further, if the War of 1914–18 may be regarded as a precedent, the problems of native Africa, when peace comes, will not be such as can be solved by improvisation, but only on a basis of the results of carefully digested scientific study over a considerable period.

African Native Institutions and Christianity

A STRIKING instance of the adaptation of African institutions and ways of thought to the promotion of Christianity after intensive study is contributed to the current issue of *Africa* (13, 1, January 1940) by Prof. N. de Cleene. Incidentally, it illustrates the flexibility, to which reference is often made, of Catholic Missions in dealing with native races. In response to a suggestion made by Prof. de Cleene that native art might be of service in the Christianization of Africa, the R. P. A. Walschap, a missionary in the Belgian Congo, made a scientific study of native music and the dance. Being struck by the predominating part played in native appreciation by the element of rhythm, not only did he introduce it into his church services, composing a mass and other music in native style, to be sung to the accompaniment of native instruments, but he also arranged a series of religious dances, in the native convention, for performance at the religious festivals of the Church. The result was a remarkable accession of interest and understanding.

The second example makes use of the graphic arts. The R. P. Vandenhoudt, from the time of his arrival on the Lower Congo some years ago, had made a study of the principles, methods and concepts of native graphic art. He was much struck with native ability in making crude but graphic representations of scenes and events in everyday life. He thereupon conceived the idea of representing scenes from the Holy Scriptures according to native concepts and in native technique. Among a number of scenes to which the method was applied, the most successful, and one which was immediately understood, was the sacrifice of Isaac by Abraham, in which the intended victim was represented according to a native custom, in which the head of a man condemned to be beheaded was fastened to the bent bough of a tree and shot into the air when the fatal blow was struck.

The British Museum (Natural History)

THE important entomological collections, manuscripts, etc., bequeathed by the late William Miller Christy have been received at the Museum. The total number of specimens is 21,312. The collection consists entirely of British Lepidoptera, and includes a large number of specimens which will be of great value as additions to the existing British collection. Mrs. Brownlow, who inherited them, has presented to the Museum a large number of important entomological books from the library of the late Mr. Christy. Further specimens of vanadinite (lead vanadate), including a doubly terminated crystal from Abenab, South West Africa, have been presented to the Department of Mineralogy by Mr. J. N. Justice, and the Department has also acquired two fine specimens of the rare potassium barium zeolite harmotone collected during the summer of 1939 at Ben Resipol, Argyll.

The Trustees of the British Museum decided at their meeting on January 26 that certain of the galleries in the Natural History Museum should be opened to the public on Saturday and Sunday afternoons, beginning on February 3. Much material has been evacuated for greater safety, and many exhibits have been protected in their places in the galleries. There remains, however, a very large proportion of the exhibits in certain galleries, and the Trustees are anxious that the public should have access to them so far as possible. In addition, it is hoped to organize a number of special exhibits of topical interest, about which a further announcement will be made at a later date. The hours of opening will for the present be from 1 p.m. to 4 p.m. (on Saturdays and Sundays only), but the closing hour will be extended as soon as the lengthening of the days and the introduction of summer time make this practicable. Children below the age of twelve will not be admitted unless they are in the charge of an adult, and visitors are requested to carry gas masks.

The Newcomen Society

AT a meeting of the Newcomen Society held at the Institute of Marine Engineers on January 17, Eng.-Capt. E. C. Smith read the second part of his paper on "The First Twenty Years of Screw Propulsion 1838–1858". Having in Part 1 dealt with the work of John Ericsson in the United States, Capt. Smith gave a review of the early progress of screw propulsion in both the Royal Navy and the British Mercantile Marine. The first screw vessel in the Royal Navy was the curious little *Bee* of 33 tons and 10 horse-power built in 1842 and fitted with a side-lever engine driving both paddle-wheels and a screw. The *Bee* for many years was attached to the Royal Naval College, Portsmouth, for the instruction of officers in steam. The first screw man-of-war in the Navy was the sloop *Rattler*, the trials with which in 1844–45 led to the screw being adopted for practically all naval vessels. By 1850 there were about forty screw ships in the Fleet, by 1858 and about 350. Generally speaking, in the larger wooden ships the screw was regarded as an auxiliary and was fitted so that it could be lifted out of the water.

The first mercantile screw vessel to make a sea voyage was the *Novelty* of 1841. The famous iron screw ship *Great Britain* was laid down in 1839 and completed in 1845. She was the first screw ship to cross the Atlantic, but a regular service to America by iron screw ships was not started until 1850, when the *City of Glasgow*, the first ship of the old Inman line, made her appearance. The year 1850 also saw the mails sent from Plymouth to the Cape for the first time by steam. Quite small iron vessels were used, and some of them were fitted with Joseph Maudslay's feathering screw. By January 1, 1857, the Board of Trade register included about five hundred screw-driven vessels, nearly all of them being constructed of iron. A second paper read at the meeting was by Mr. A. S. Davies, and consisted of some extracts from the ledgers of the Coalbrookdale Company relating to castings for Newcomen engines between 1717 and 1769.

X-Rays in Industry

METHODS of utilizing X-rays in industry were discussed in a lengthy paper by Mr. H. P. Rooksby, of the Research Laboratories of the General Electric Co., Ltd., in a paper read before the Royal Society of Arts on January 17. The methods of utilizing X-rays fall into two groups which depend (*a*) upon their power of penetration through various materials, and (*b*) upon their reflection by the regular arrangement of atoms in crystalline substances. The varying resistance of materials to penetration by X-rays enables a kind of density picture of a complex object to be obtained by irradiating the object with X-rays and examining the emergent beam by means of a photographic plate or fluorescent screen. This use is widely known.

Another use for X-rays concerns the continuous series of solid solutions formed by luminescent zinc/cadmium sulphides. Members of this series are used extensively in the manufacture of the screens of the cathode ray tubes, and for colour modification of certain mercury vapour discharge lamps. New fluorescent colours are often obtained by blending two zinc/cadmium sulphides of different compositions. A chemical analysis alone will not reveal when this has been done. The X-ray method enables the composition of both phases to be determined, as each phase will show up separately on the X-ray pattern. In some manufacturing processes, it is necessary to determine what effective heat treatment has been given to a sample of coke or 'amorphous' carbon. It is found that the ultimate particle size of amorphous carbon depends more upon the actual temperature of heat treatment than upon any other factor, so that the temperature to which a given sample has been treated can be ascertained with reasonable accuracy by comparison of its X-ray pattern with those of the standard period of cokes. In conclusion, the author emphasizes the fact that few recognize how wide is the scope of X-ray analysis. Certain physical properties such as the coefficient of expansion, which can be easily measured in the classical way, have also been measured by X-ray methods, and satisfactory agreement has been found. These new methods should not be regarded as merely repetitive, for new aspects of the physical property may be revealed by the new method of approach.

The Friendship of Boyle and Wren

IN a recent paper (*Bull. Hist. Med.*, 7, 970 ; 1939) Ruth Musser and John C. Krantz, jun., relate that Robert Boyle and Christopher Wren first became acquainted in London in 1648 when Boyle was aged twenty-one and Wren sixteen. In 1664, when both were at Oxford, Wren, who had been made Savilian professor of astronomy four years previously, conceived the idea of conveying medicines or poisons directly into contact with the blood of animals by inserting pipes directly into their blood vessels. The experiment was carried out on a dog in collaboration with Boyle at an Oxford meeting of the Royal Society at Wadham College, of which Wren was a member. The first experiment was made with a warm infusion of opium which was injected into one of the superficial veins of the dog's hind leg and produced profound stupor in the animal. Afterwards, experiments were made with an infusion of brown antimony oxide, which caused vomiting and was nearly fatal. Diuretics were injected at the suggestion of a famous physician who may have been Willis, and lastly transfusion of blood from one animal to another was carried out with considerable success. The experiments were brought to an end by the outbreak of plague in the summer of 1665, when Wren went to Paris, but the friendship of these two great men continued, owing to their activities connected with the Royal Society, until Boyle's death in 1691.

Meteorology in India

THE report on the administration of the Meteorological Department of the Government of India in 1938–39 covers a period during which an important stage in the re-organization of the department was completed. The scheme was planned to involve no increase in the budget grant and yet to give the following additional facilities : (1) an afternoon weather chart for the headquarters office at Poona ; (2) the re-establishment of the forecasting centre at Delhi ; (3) the establishment of a wireless station at Poona ; (4) re-organization of the superior staff; (5) the transfer of the upper air office from Agra to Delhi ; (6) an increase of staff in the R.A.F. Meteorological Offices and the setting up of additional observatories in North-West India.

The aerological observatory at Agra dates from 1914. It was originally just a research station, and the position was chosen solely with the view of getting the maximum possible information about the upper atmosphere with the aid of sounding balloons. The growth of aviation has involved the observatory in an ever-increasing number of administrative and purely utilitarian activities, and for these Agra is a backwater. It is accordingly being transferred to a new 20-acre site that has been chosen at Delhi, where it can come into closer contact with aviation interests and where it will have access to the upper wind charts prepared in the normal routine of daily forecasting.

The Imperial Council of Agricultural Research continued to finance the Agricultural Meteorology Section, although proposals were under consideration for making the section a permanent part of the department. New developments in this section included the construction of a 35 ft. tower at the Central Agricultural Meteorological Observatory, for the study of exchanges of heat and moisture between the surface layers of the soil and the atmosphere. The Calcutta office issued storm warnings during sixteen periods of disturbed weather over the Bay of Bengal. The outstanding cyclone of the year in that region was that of October 5–12, 1938, which on approaching land caused much damage and some loss of life in the Ganjam district when sea waves inundated the coastal areas and swept away houses and cattle. The Poona office had a greater number of disturbed periods to deal with over the Arabian Sea, and one cyclone redeveloped into a very severe storm early in October after having weakened during its passage across the Peninsula from the Bay of Bengal.

The Bureau of Human Heredity

THE Bureau of Human Heredity is carrying on, though with reduced activity, during the War. Although some international connexions are cut off, a compensation is the possibility of obtaining a median sample of the population through the careful examination of entrants for the Services. This is not to be lost sight of, as collaboration with medical men in examining and collating genetical conditions would be of great importance in furnishing figures of medical, anthropological and genetical value. Although the Bureau has lost several workers, it has enlisted the support of Prof. F. A. E. Crew as honorary medical secretary. Correspondence with men of science in other countries continues, but in diminished volume, which may give time for other projects, including (1) surveys of the genetic background in tuberculosis, (2) the human analogue of the transmission of cancer in animals, (3) certain immunological problems. It is hoped also to compile a preliminary list of inherited disorders and defects based on recent research for the use of practitioners and teachers. The address of the Bureau is 115 Gower Street, London, W.C.1.

Cereals for Spring Sowing

THE National Institute of Agricultural Botany has just issued a war-time leaflet (Farmer's Leaflet, No. 2, "Varieties of Cereals for Spring Sowing"). Its appearance is opportune, for it both presents an epitome of spring oats and barley in the light of their general utility, as well as their possible substitution on land which was primarily intended for wheat, but which may yet be unsown owing to unfavourable weather. There are also some varieties of wheat normally used for autumn sowing which can be sown up to the end of February with reasonable chances of success. Quality in home-grown wheat at the moment is in abeyance; but other things being equal, the same condition does not apply to oats. These are mainly intended for consumption on the farm, and the value of oat grain for all forms of stock feeding is determined by the amount of husk the grain contains. Thus, where the farmer is in a position to exercise a preference, it should be in favour of a variety with as thin a husk as possible.

In recent years nothing has happened to impair the reputations of Spratt-Archer and Plumage-Archer barleys amongst farmers and maltsters, and in general the recommendation of these varieties cannot be improved upon. There is, however, a case for the Danish varieties Kenia and Maja on rich soils, since both these barleys are early in ripening and both possess shorter and better standing straw than either of the two varieties mentioned above. On less rich soils, and where earliness in ripening is a requisite, the native varieties Standwell and Maltster may be utilized with advantage. Copies of the leaflet may be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

Mr. A. H. Mackmurdo

THE communication entitled "The Social Organism", printed on p. 187 of this issue, has additional interest in the age and associations of the author. Mr. Mackmurdo, who is eighty-nine years of age, is believed to be the only man living who can claim to have been a friend both of Charles Darwin and of Herbert Spencer. For many years he worked with Spencer, and seventy years ago, at the age of nineteen years, he began his subscription to NATURE at the suggestion of Charles Darwin.

Announcements

CAPTAIN ROBERT KEMP has won the Buckston Browne prize for 1939 with an essay on the value of periodic medical examination in middle life.

DR. ETIENNE BURNET, director of the Pasteur Institute of Tunis, has been made a Commander of the Legion of Honour.

DR. C. G. DARWIN will deliver the thirty-first Kelvin Lecture of the Institution of Electrical Engineers on April 25, at 6 p.m. The title of Dr. Darwin's lecture will be "Thermodynamics and the Coldest Temperatures".

MESSRS. W. AND R. CHAMBERS, LTD., announce the early publication of "Chambers's Technical Dictionary". This single volume work contains terms drawn from many branches of scientific and industrial activity, and is under the editorship of C. F. Tweney and Dr. L. E. C. Hughes.

IN memory of the late Prof. V. R. Williams, the Russian authority on soils, the Timiryazev Agricultural Academy in Moscow has founded three annual prizes to be awarded for the best work on soil study and cultivation. The first prize is of 5,000 roubles, the second of 3,000 roubles and the third of 1,500 roubles. The Commissariat of Agriculture is preparing for publication a complete collection of Prof. V. R. Williams' work. New editions of the most important of them will be published this year.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 191. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

3 : 4-Benzpyrene, Paramecium and the Production of Tumours

THE blastogenic hydrocarbons are photodynamic; therefore, in order to observe their action on living cells, cultures must be kept in the dark, and examined in light not shorter than 410 $\mu\mu$. Under these conditions, using 3 : 4-benzpyrene and Paramecium, it has been shown that growth-rate is increased; this effect thus reproduces in a test-tube the increased cell-growth observed when the hydrocarbon is applied to the tissues of vertebrates, for example, the hyperplasia of the epidermal cells, when the skin of mice is painted[1].

Continuing this line of research, I have tried to reproduce the conditions under which tumours arise. This has necessitated the cultivation of Paramecium for a long time in a medium containing 3 : 4-benzpyrene; to keep the cultures going, they had to be sub-cultured two or three times a week.

Two sets of experimental cultures were maintained, containing one in a million benzpyrene, and one in five hundred thousand. In the latter, a few large organisms of abnormal shape were found on the sixty-second day. Similar abnormal organisms were also found in the one in a million cultures on the hundred and twenty-second day. This strain of Paramecium has been continuously under observation for more than two years and never have any abnormal forms been seen, either in control or experimental cultures.

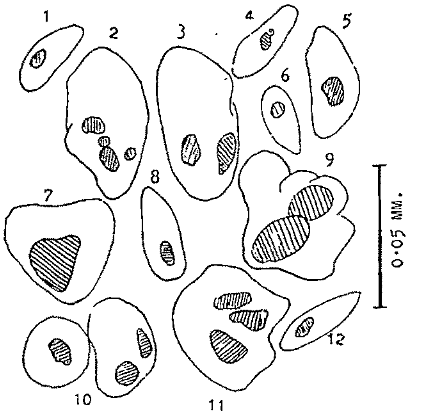


Fig. 1.

OUTLINE DRAWINGS OF SPECIMENS FIXED IN 'SUSA' AND STAINED WITH CARMALUM.

The ruled areas are macro-nuclei; Nos. 1, 4, 6, 8, 12 are normal Paramecia; No. 10 is about to divide into two.

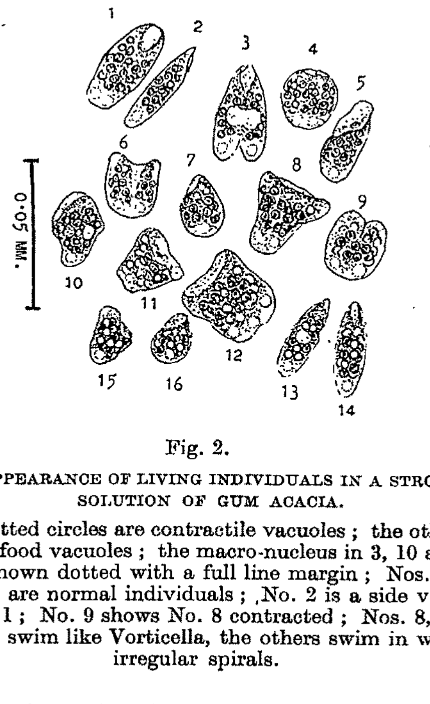


Fig. 2.

THE APPEARANCE OF LIVING INDIVIDUALS IN A STRONG SOLUTION OF GUM ACACIA.

The dotted circles are contractile vacuoles; the other circles food vacuoles; the macro-nucleus in 3, 10 and 13 is shown dotted with a full line margin; Nos. 13 and 14 are normal individuals; No. 2 is a side view of No. 1; No. 9 shows No. 8 contracted; Nos. 8, 11 and 12 swim like Vorticella, the others swim in wide irregular spirals.

The experimental cultures never underwent conjugation. Furthermore, after the abnormal specimens were removed from the cultures, the cultures continued to present only normal forms. Later, single abnormal forms again occurred in the one in five hundred thousand culture on the eighty-third day, and in the one in a million on the one hundred and sixty-fifth day.

The abnormal specimens were picked out and placed in normal media as single-cell cultures: they grew into populations of abnormal Paramecia, some many times the normal size, some midgets, some 'Siamese twins', some triplets, some no more than knobbly monsters, some presenting little departure from the normal and some apparently quite normal.

Outline drawings of some of these fixed with 'Susa' and stained with carmalum are shown in Fig. 1; examined in gum, their appearance in life is well seen and illustrated in Fig. 2.

These abnormal forms have been sub-cultured in normal medium for several months by picking out single individuals. When sub-cultured by using a platinum loop, normal forms, which are often the progeny of the abnormal, quickly outgrow the abnormal, which thus become lost.

Breeding out various abnormal forms shows how this comes about: certain of the abnormal types, especially twins and triplets (Fig. 2, Nos. 3, 10 and 12), throw normal as well as abnormal individuals. Some of the abnormal forms, however (Fig. 2, Nos. 7, 11, 15 and 16), breed true and have been kept in pure culture for many generations by sub-culturing with a platinum loop. Thus, long exposure of Paramecium to benzpyrene results in the production of a set of polymorphic cells. Here we have a striking resemblance to the assemblages of cells of which tumours are composed; it is well known that the cells from a single tumour are widely polymorphic both in size and structure: for example, their content of chromosomes may be either normal, above the normal, or below; cells with many times the normal number are common.

The similarity between the formation of a tumour by benzpyrene and the changes observed in Paramecium thus embraces the following facts:

(1) They occur among cells long stimulated to a growth-rate above the normal.

(2) They occur only after long exposure to the hydrocarbon.

(3) Only a very few of the exposed cells present the change.

(4) Once the change has occurred, it is reproduced by cell division for many generations after the hydrocarbon has been removed.

(5) The population of cells which result show wide morphological variation.

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Jan. 1.

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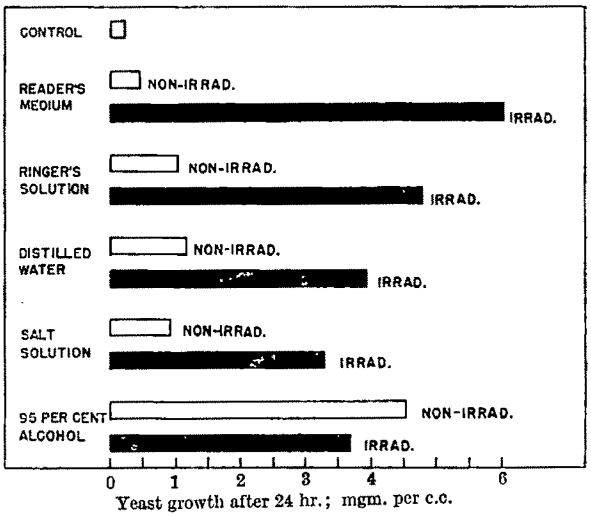
[1] Nature, 144, 154 (1939).

Effect of the Suspending Medium on the Production of Growth Factors by Injured Cells

In investigating the production of proliferation-promoting intercellular wound hormones by cells injured by various means[1], a study has been made of the effects of the suspending media on the production of the factors by cells injured with lethal ultra-violet radiation.

Reasoning that if the proliferation promoters are physiological products of living cells, the ratio of the production of the factors by irradiated and non-irradiated cells should be greatest when they are suspended in a favourable medium, containing nutrient material, a comparison was made of the production of the factors in distilled water, isotonic sodium chloride, Reader's medium[2], 95 per cent ethyl alcohol, and Ringer's glucose phosphate solution. Yeast was suspended in these media at a concentration of 100 gm. per litre. All suspensions were irradiated simultaneously with lethal ultra-violet until there was practically complete killing in the salt solution. The suspensions were then filtered through Berkefeld *N* filters, and the filtrates taken to dryness and made up to five times their original concentrations. These solutions were assayed on yeast according to techniques previously described[3].



The results of typical assays are shown in the accompanying illustration. The greatest production of the factors by irradiated cells and the least by non-irradiated cells occurred in the most favourable medium (Reader's). Next followed Ringer's glucose phosphate solution. In distilled water and salt solution, in which the cells had no nutrient supply, the ratio of irradiation products to controls, as well as the potency of irradiation products, were less, as would be expected if the factors were elaborated by living cells and not simply extracted from killed cells. There was somewhat greater release of proliferation-promoting factors by both non-irradiated and irradiated cells in distilled water as compared with salt solution, evidently due to the lowered osmotic pressure in the former favouring extraction. In alcohol, irradiation led to less, instead of greater, yields, the toxic effects of alcohol and irradiation together apparently killing the cells too quickly to permit as great elaboration of the factors as in alcohol alone. Were the factors dead-cell disintegration products, one would not expect any decreased yield in alcohol as a result of irradiation unless irradiation destroyed the active factor. That this could not have accounted for the lesser yields obtained was determined by separate experiments on the irradiation of active filtrates, the degree of inactivation being negligible under the conditions of the experiments.

The results indicate that disintegration of dead cells cannot account completely for the proliferation-promoting products obtained from injured cells, and support the hypothesis that injured cells release such factors into their suspending media as a physiological response to injury.

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Institutum Divi Thomae,
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Sister Cecilia Marie Dwyer, S.C.

Research Laboratory of
Good Samaritan Hospital,
Dayton, Ohio.
Dec. 7.

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[1] Fardon, Norris, Loofbourow and Ruddy, Nature, 139, 589 (1937); Sperti, Loofbourow and Dwyer, Nature, 140, 643 (1937), *Studies Inst. Divi Thomae*, 1, 163 (1937); Sperti, Loofbourow and Lane, *Science*, 86, 611 (1937); Loofbourow, Cueto and Lane, *Arch. exp. Zellforsch.*, 22, 607 (1939); Loofbourow and Dwyer, *Science*, 88, 191 (1938), Nature, 143, 725 (1939), *Studies Inst. Divi Thomae*, 2, 155 (1939); Loofbourow and Morgan, *J. Bact.*, 38 (1939), in the press.

[2] Reader, *Biochem. J.*, 21, 901 (1927).

[3] Loofbourow, Dwyer and Morgan, *Studies Inst. Divi Thomae*, 2, 137 (1938).

Under Coat of the Platypus

As a refugee from China where, at Chiao-Tung University and the Lester Medical Research Institute, I had been studying the structure of the wool fibre, I was offered the hospitality of the Zoological Department of the University of Melbourne by Prof. W. E. Agar, and the investigations there carried out have given rise to the matters here brought under discussion.

To disintegrate the wool fibre I had reason to steep it in a concentrated solution of caustic potash from a half to three hours. On washing in water, after this steeping, a curious phenomenon was witnessed. The wool fibre took on a beautiful regular curvature. On treating a medullated fibre in like manner, although the fibre in its natural state was perfectly straight, after treatment it took on the curvature shown in Fig. 1 with the medulla broken into short lengths. It at once occurred to me that these lengths each represented a day's growth. If this were so then there would be approximately 365 of these for a year's growth, and multiplying this number by the unit length should give the fibre length of one year's growth. This I found to be approximately correct.

One explanation of the effect here observable appears to be that the cortex of the fibre contracts while the medulla does not do so and consequently is constrained to take up the positions shown. A normal wool fibre without medulla shows a similar curvature when similarly treated, this probably being due to the different contractions of scale sheath and cortex. The periodicity of the break along the normal wool fibre is about equal to twelve diameters, that is, about one hundredth of an inch with a typical Merino wool fibre. The curvature of the wool fibre in the lock or staple is partly to be attributed to this periodicity and partly to the varying lengths of fibres composing each staple. Thus the shorter fibres decide the length of the staple and the longer fibres, of necessity, take on the curl or crimp to fit themselves to this length. On looking at the coat of the platypus in the University Museum, I was naturally struck with the 'ladder' structure shown in Fig. 2, and it was but a step further forward to ask: Is this ladder structure due to the daily periodicity—does each ladder represent a day's growth of the fibre?

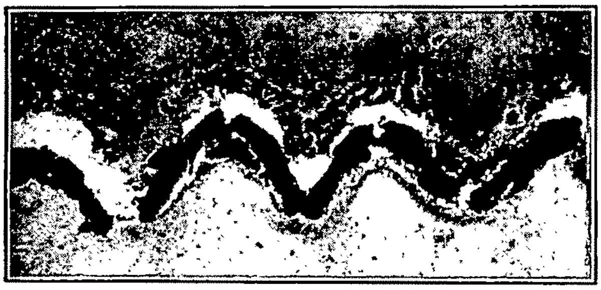

Fig. 1.

MEDULLATED FIBRE CURVED AFTER TREATMENT WITH CAUSTIC POTASH. (× *c.* 36).

Unit length approximately $\frac{3}{4}$ and $\frac{3}{4}$ of $\frac{1}{45} = \frac{1}{60}$ or 60 breaks per inch. And 365 days ÷ 60 = 6 inches, length of fibre for one year's growth.

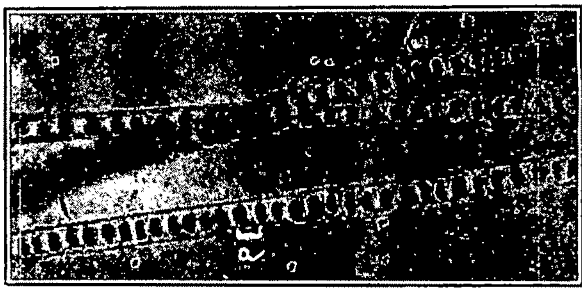

Fig. 2.

LADDER STRUCTURE OF UNDER COAT OF PLATYPUS. (× *c.* 330).

One ladder = $\frac{1}{8}$ in., and 440 × 8 = $\frac{1}{3520}$ length of each ladder. Fibre $\frac{1}{2}$ in. long, therefore $\frac{3520}{2} = 1760$ ladders or days. And $\frac{1760}{365} = 4$ years and 300 days. (Age of Animal).

By the kind collaboration of Mr. Kendall of the Melbourne Zoological Gardens and Mr. David Fleay of the MacKenzie Sanctuary, Healesville, near Melbourne, I was able to obtain fibres from two animals of known age, and on testing out the theory I was surprised and naturally delighted to find the wonderful coincidence as shown in the following table:

	A	*B*	*C*	*D*	*E*
Fibre length	$\frac{1}{2}$ in.	$\frac{1}{4}$ in.	$\frac{1}{4}$ in.	$\frac{1}{2}$ in.	$\frac{1}{3}$ in.
Length of ladder	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$	$\frac{1}{3000}$
Ladders per fibre	1500	750	750	1500	1000
Age by ladders	$4\frac{1}{9}$	$2\frac{1}{18}$	$2\frac{1}{18}$	$4\frac{1}{9}$	3 (nearly)
Actual age	Well over $2\frac{1}{2}$	2+	2+	Not known	Not known

A is the Zoo platypus; *B* "Jack" from the Sanctuary; *C* "Gill" from the Sanctuary; *D* from the University Museum; and *E* a stuffed specimen from the Zoological Gardens.

This, however, seemed too good to be true, so I set to work to examine each coat thoroughly, and to my chagrin I found a fibre in the coat of Gill, one of the Sanctuary animals of known age, much too long to fit in with my theory. At the same time, however, I noticed the waved character of the fibres and, from my experience with wool staples and fibres which had shown a similar effect due to the variation in lengths of the fibres composing the staple, I at once thought of different rates of fibre growth which would account for this long fibre. But if my theory were correct there would only be the same number of ladders upon this longer fibre as upon the shorter fibres—in other words, the ladders would be longer. On measuring the ladders on this longer fibre I found that they were longer and that consequently on the longer fibre there would only be the same number of divisions as on the shorter, slower growth fibres. The following are the details:

For *C* ("Gill" from the Sanctuary):

Longest fibre	$\frac{1}{3}$ in.	Average fibre	$\frac{1}{4}$ in.
Length of ladder	$\frac{1}{2590}$	,, ,,	$\frac{1}{3000}$
Ladders per fibre	863	,, ,,	750
Age by ladders	$2\frac{1}{3}$	,, ,,	$2\frac{1}{18}$
Actual age	2+	,, ,,	2+

As these ladders are approximately only about one three thousandth of an inch in length, it is wellnigh impossible to count the ladders for even a two years' growth. It would seem, however, that the theory here set forth, that each ladder represents a day's growth of the fibre, is likely to be correct.

There is, however, one other matter to be considered which might invalidate the whole argument: Is the coat of the platypus composed of life-length fibres or only of year's-growth fibres? Does the platypus retain its under coat for its life or does it 'moult' or cast its coat yearly? Curious to relate, certain animals, such as the musk ox, cast their under coat yearly, but the Merino sheep, which according to the late Prof. Cossar Ewart has thrown off the outer hair coat of the wild sheep and retained only the under coat, does not cast this under coat: Merino sheep have been sheared carrying a five-years' growth of wool.

I would therefore ask the help of other workers in the elucidation of the two problems basic to the theory here advanced:

(1) Do the animals carrying a 'laddered' under coat cast this coat yearly, or do they retain the under coat for life, the life-histories of the animals being shown on the fibres just as the age and history of a tree are revealed by the rings from bark to centre?

(2) Is the 'ladder' truly representative of a day's growth of the fibre in the case of animals other than the platypus which show this ladder structure of the fibre?

Aldred F. Barker.

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The University,
Melbourne.

The Social Organism

In the last few years science has thrown her searchlight upon social physics, making amazing discoveries. She shows that there are laws underlying social physics as immutable as those she has discovered in material physics. This fact compels the assumption that the evolution of social bodies follows the pattern of all organisms in an increasing specialization of parts with a reciprocal unification of structure. This means also that a society in its evolution becomes a social organism. The facts disclosed by science lead to no other interpretation.

In our study of natural history which now includes the history of societies, we find that all beings—mechanical, vegetal and animal—may be classed in a serial order ranging from the most simple to the most complex, and from a motor-car to a social organism. In the inevitability of this order man will find he has a sure guide to control his interference with and to direct his assistance to Nature's process of social evolution. Hence the call everywhere heard for the help of science in the work of social organization.

So long as we ranged social phenomena as a class apart from physical phenomena, science could not pass the frontiers of the latter. She had to concentrate upon improvements in mechanics and chemistry.

One cannot organize a heap of sand. Before a body can be organized there must be some binding element tending to integrate its diverse parts into a whole. This necessity becomes more evident as organisms rise in the order of their complexity. In the long past this binding element was supplied by the general concept of a superhuman power. To-day this concept is no longer general. Societies have been trying to pull themselves together either by a common defence of material possessions or by a common defence of personal rights.

But science alone can supply the missing link between the individual and society. This link is in the new conception of the social body as an organism in process of development.

The supernatural concept of the past had reference only to the individual, and in its decay it has given rise to an unrestrained individualism which has engendered disorganization and disruption instead of organization and integration.

A modern society is composed of individuals who are forced to live in association and to maintain their life by co-operation. This is the new phase and one pointing directly to the organization of the maintaining activities in accord with the law of organic life.

In the absence of scientific direction, we have been intensifying the specialization of the individual without any compensating balance in the form of a common conception such as will induce the highly specialized individuals to direct their specialized competence in building up a welfare beyond that of the individual, but one within which the welfare of each would be embodied.

In this lack of any integrating influence in the presence of elements which are in themselves disintegrating, lies the cause of the restiveness and the antagonisms of the present day in almost every European nation.

The universal instinct of man is restless in its search for law and order, and if it find no real law and order outside his own consciousness, he will create a fictitious law and order—Bolshevism, Socialism, and what not.

Here social science, which is the capital science, together with all the sciences preliminary to this, from astronomy to physiology, may keep societies out of the bog into which they are drifting. Never before has science had such an opportunity of educating and directing the civilities which constitute the civilization of mankind. By insistence upon the recognition of each body-politic as a social organism true to type, and by the habit of a conception which will enlarge the aim of science, industry and arts, this enlargement of the social functions will cause a new social structure to arise for their ample accommodation; which sociological structure will follow the pattern of physiological structures.

By the process of evolution millions of unicellular organisms have been brought into organic integration to form a multicellular physiological structure—vegetal, animal or human. By the same process Nature is incorporating millions of individuals in a multipersonal organism. This is the positive fact upon which social science is built.

A. H. Mackmurdo.

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Witham,
Essex.
Jan. 5.

Energy Changes Accompanying Magnetization

It is generally stated that the heat evolved in a hysteresis cycle is given by the expression $\int H dI$, where I is the intensity of magnetization of a ferromagnetic specimen in an effective field H, although it is very difficult to provide an adequate proof of this statement. In recent years several attempts have been made to investigate the heat liberated or absorbed when a ferromagnetic is taken through the several stages of a single hysteresis cycle step-by-step. Thus, Adelsberger[1] found that the total quantity of heat liberated by unit volume of a hard steel in a single complete cycle is equal to that calculated from $\int_{-H}^{+H} H dI$, and so provided a proof of what is known as Warburg's Law.

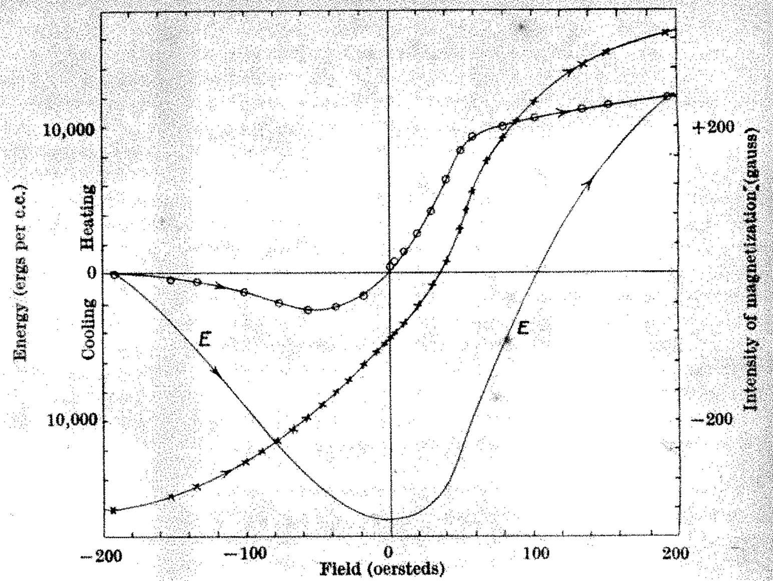

Fig. 2.

Stress 8·67 kgm./mm.².

Now, while there is little doubt about the correctness of this law, there is much uncertainty about the heat changes accompanying the magnetic changes taking place when a cycle is described in a step-by-step process. This is because the temperature changes are exceedingly small; for example, in the very favourable case of a hard steel, the total rise in temperature when its magnetism is reversed in an ordinary laboratory experiment is only about 0·005° C. Consequently, all experiments which have hitherto been made have relied either upon the use of multiple thermojunctions electrically insulated from, but in thermal contact with, a ferromagnetic rod, or upon the use of multiple specimens, each of which acted as one metal of a thermocouple, or upon the use of a divided specimen to each portion of which a thermojunction was attached, the several thermocouples being connected in series to a sensitive galvanometer. References to these experiments will be found in a recent paper by Hardy and Quimby[2].

We have recently developed in this laboratory a new and sensitive method which permits the measurement of sudden changes in temperature when some twenty thermojunctions are connected directly to an undivided rod about 5 mm. in diameter and 40 cm. long. Incidentally, the method could readily be used to measure the rate of change of the modulus of rigidity of a metal with rise in temperature. The great advantage of our method is that it enables us to measure the thermal changes accompanying magnetization processes when the rod is subjected to a steady severe longitudinal stress. In this way we have been able to obtain measurements with a hard-drawn, unannealed nickel rod, 99·67 per cent pure, the main impurity being magnesium, kindly supplied by Dr. L. B. Pfeil, of the Mond Nickel Company Research and Development Department, when under tensions of 1·70, 3·72, 5·28, 8·67, 12·1, 21·4 and 31·2 kgm. per sq. mm.

Some of the results are shown in the accompanying graphs, in which the curves drawn through the crosses are the I, H curves, the curves E represent the energy changes calculated from the I, H curves on the assumption that the expression $\int H dI$ is adequate, while the encircled points are the results of our direct measurements. Fig. 1 refers to the unstretched nickel rod, and here the agreement between the calculated and the measured results is extra-

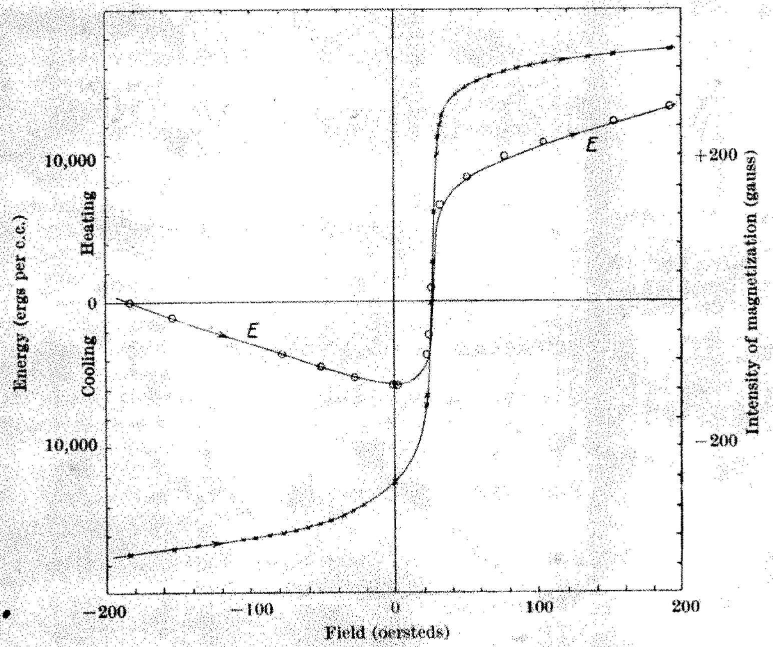

Fig. 1.

Zero stress.

ordinarily close. In our view, it is fortuitous, as we have not found such close agreement with another, slightly purer, specimen. Fig. 3 refers to the same rod under the severe stress of 31·2 kgm. per sq. mm., and is very interesting because all trace of cooling on demagnetization has vanished and no reversible changes of any kind appear. Now, Becker[3] deduces that in the case of heavily stretched nickel the entire magnetization is caused by reversible rotation of Weiss domain vectors which are forced by the severe tension to set perpendicularly to the axis of the rod in the absence of a longitudinal field. Our experiments therefore show that such processes are unaccompanied by measurable heat changes. The results of Fig. 2 are for the same rod loaded to 8·67 kgm. per sq. mm., and represent a transition stage between those of Figs. 1 and 3.

In conclusion, we wish to direct attention to the proof of Warburg's law, the lack of correspondence between the calculated heat changes and those measured directly in step-by-step alterations of *H*, and the significance of the measurements on nickel under severe tension arising from these experiments. It is hoped to publish a complete description of the method and the measurements on nickel and several nickel alloys in the near future.

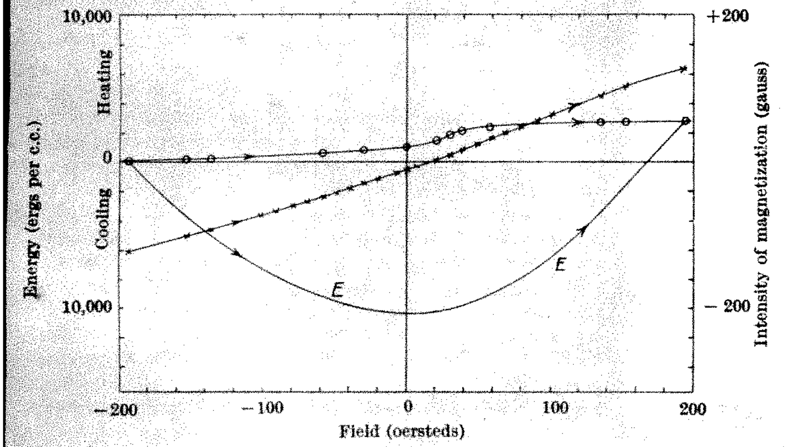

Fig. 3.

STRESS 31·2 kgm./mm.^{2}.

University College,
Nottingham.
Dec. 20.

L. F. BATES.
J. C. WESTON.

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[1] Adelsberger, U., *Ann. Phys.*, **83**, 184 (1927).

[2] Hardy, T. C., and Quimby, S. L., *Phys. Rev.*, **54**, 217 (1938).

[3] Becker, R., and Döring, W., "Ferromagnetismus", p. 111 (1939).

Diffraction of Convergent Electron Beams

IN a recent paper[1], Kossel and Möllenstedt describe some beautiful experiments on the diffraction of convergent electron beams by transmission through thin crystals. Whereas very thin crystal flakes (or flakes of not perfectly uniform thickness ?) show the diffraction pattern of a two-dimensional lattice, the diffraction spots of mica crystals some 500–1000 A. thick show a fine structure of approximately equidistant stripes (Fig. 1) which Kossel and Möllenstedt interpret as being due to the secondary maxima of the Laue interference function

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{N}{2}c\,(\cos\theta_m-\cos\theta)\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}\cdot\frac{1}{2}c\,(\cos\theta_m-\cos\theta)\right\}},$$

where *c* is the identity period normal to the crystal surface, *N* is number of cells in this direction, θ is the angle between incident beam and *c*, θ_m is the angle between diffracted beam and *c*. With $\theta_m+\theta=2\theta_0$ (interference condition of the crystal surface[1]), where θ_0 is the Bragg angle of the reflection plane—which is perpendicular to the surface—and considering the smallness of all the angles, this may be written

$$\frac{\sin^2\left\{\frac{2\pi}{\lambda}Nc\,(\theta-\theta_0)\sin\theta_0\right\}}{\sin^2\left\{\frac{2\pi}{\lambda}c\,(\theta-\theta_0)\sin\theta_0\right\}}, \quad . \quad . \quad . \quad . \quad (1)$$

which function shows minima for

$$\theta-\theta_0=\frac{md_{hkl}}{D} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where d_{hkl} is lattice plane distance, $D=Nc=$ thickness of the crystal, and *m* is any integer save 0, $\pm N$, etc.

However, this explanation based on the kinematic diffraction theory does not account fully for the details of the phenomenon: The distance between the minima $m=+1$ and $m=-1$ should be twice the distance between the minima *m* and $m+1$, whereas it is almost invariably much smaller than this expected value. Kossel and Möllenstedt, being fully aware of this fact, describe it qualitatively in terms of a dispersion with direction of the wave-length, as found in the dynamical theory of crystal diffraction. It seemed worth while to apply directly the formulæ given by this theory and, if possible, to test them.

The dynamical theory of electron diffraction by crystals has been given by Bethe[2], who, however, developed it only for the 'Bragg case' (reflection pattern); in working out the theory for the 'Laue case' (transmission diagram) along the lines followed by Ewald and others[3], a complete analogy to Ewald's *Pendellösung* is found, as might, of course, be expected. Neglecting terms of higher order, we find for the relation between the amplitude c_m of the diffracted c_0 of the incident beam :

$$\frac{|C_m|}{|C_0|}=\frac{|V_{hkl}|}{k^2}\,\frac{\sin\frac{1}{2}Dk\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+\frac{|V_{hkl}|^2}{k^4}}}{\frac{1}{2}\sqrt{(\theta-\theta_0)^2\sin^2 2\theta_0+|V_{hkl}|^2/k^4}}, \quad (1a)$$

where $k=\frac{2\pi}{\lambda_{cr}}$, where λ_{cr} is the wave-length of the electron beam, modified by the average crystal potential; and V_{hkl} is the structure factor for the electron diffraction against the plane *hkl*.

In contrast to (1) it is seen that the argument of the sines in (1*a*) can no longer assume the value 0, its minimum value being $\frac{DV_{hkl}}{2k}$. Taking the experimental conditions of Kossel and Möllenstedt,

$D \approx 10^3$ A., $\lambda = 0 \cdot 058$ A., this will not exceed π unless V_{hkl} is greater than about 3 volts, which corresponds to a strong reflection. Minima are thus found at

$$\theta - \theta_0 = \pm\, d_{hkl} \sqrt{\frac{m^2}{D^2} - \frac{|V_{hkl}|^2}{4\pi^2 k^2}}\,, \quad . \quad . \quad (2a)$$

where $m = 1, 2, 3$ . . . etc.

With large m or small D, the second term under the root can be neglected compared to the first, thus leading to (2), Kossel and Möllenstedt's formula. It is easily seen that the dynamical correction term has the greatest relative influence on the distance between the first minima on either side of the maximum at θ_0; in the distances between minima on the same side of θ_0 the correction terms cancel to a great extent, in accordance with experiment.

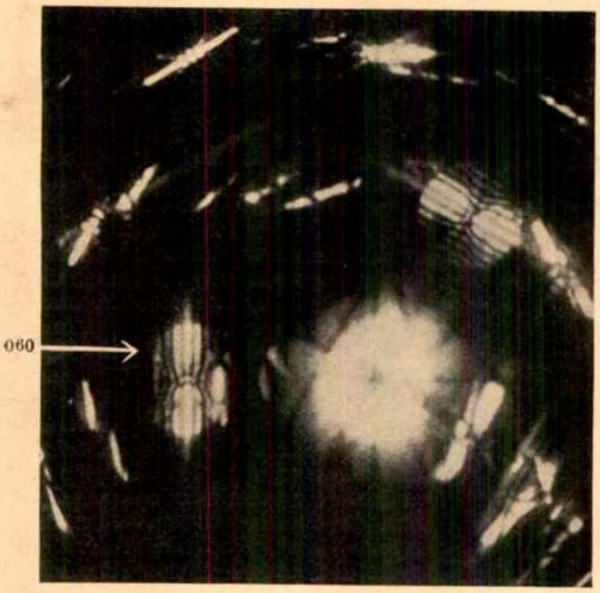

FIG. 1.

TRANSMISSION PATTERN FROM MICA WITH CONVERGENT ELECTRON BEAMS.[1]

To test (2a), V_{hkl} has been computed from the anomalous distances[4] in the diffraction spot on the left-hand side of Fig. 1, corresponding to the reflection (060). (In the figure it is seen that the position of the bands shifts when crossed by a Kikuchi line. This effect being caused by terms neglected in (2a), the distances between minima must be measured outside these regions.)

$$\frac{\theta_{+1} - \theta_{-1}}{(\theta_{m+1} - \theta_m)_{m=\infty}} = 2\sqrt{1 - \frac{|V_{060}|^2}{4\pi^2 k^2} D^2} = 1 \cdot 2,$$

where $(\theta_{m+1} - \theta_m)_{m=\infty}$ has, as a rather crude approximation, been taken from the average value of the bands $\theta_2 - \theta_1$ and $\theta_3 - \theta_2$. With $D = 900$ A. and $\lambda = 0 \cdot 058$, we find

$$V_{060} = 2 \cdot 3 \text{ volts.}$$

On the other hand, V_{hkl} was evaluated from the known atomic positions in mica, the data of Jackson and West[4] for muscovite having been used:

$$V_{060} = \frac{d^2_{060}\, e}{\pi\, a\, b\, c \sin\beta} \cdot \Sigma i\, (Z_i - F_i) e^{2\pi i . 6 Y_i / b} = 2 \cdot 1 \text{ volts,}$$

in striking agreement with the value found above.

It is thus shown to be possible to determine structure factors simply by measuring *distances* between minima in the fine structure of a diffraction spot, without any *intensity* measurement. The applicability in practice of this very remarkable way of measuring structure factors will be confined to crystal flakes of sufficiently uniform thickness; when D is not sufficiently constant, the position of the minima will shift within the region of coherence of the beam, so that the fine structure will disappear.

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Crystallographic Laboratory,
University, Amsterdam.
Dec. 21.

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[1] Kossel, W., and Möllenstedt, G., *Ann. Phys.*, **36**, 113 (1939).

[2] Bethe, H. A., *Ann. Phys.*, **87**, 55 (1928).

[3] Ewald, P. P., *Ann. Phys.*, **49**, 1, 117 (1916); **54**, 519 (1917). v. Laue, M., *Erg. d. exalt. Naturw.*, **10**, 133 (1931). Kohler, M., *Ann. Phys.*, **18**, 265 (1933).

[4] Jackson, W. W., and West, J., *Z. Krist.*, **76**, 211 (1931).

Selective Oxidation of Aluminium Alloys

IN a recent communication[1], S. Dobiński and M. Niesłuchowski state that "an explanation of such striking facts as the formation of a layer of pure MgO on the surface of an alloy containing barely one atom of magnesium for about 3,000 atoms of aluminium, chemical arguments are of little help. As a matter of fact, the heat of oxidation of aluminium (namely 190) is much greater than that of magnesium (143) or beryllium (131). 'Preferential' oxidation in the sense of greater chemical affinity of magnesium or beryllium for oxygen, or reduction of the previously formed Al_2O_3 by beryllium or magnesium, can thus scarcely be considered as a probable hypothesis".

The writers overlook the fact that in this case must be compared heats of oxidation which are related to the same amount of oxygen. The heats of oxidation of magnesium and beryllium mentioned above must be compared with the heat of oxidation of aluminium, also related to one atom of oxygen (namely, 126). The chemical affinity of beryllium and magnesium for oxygen is thus greater than that of aluminium, and the preferential oxidation of magnesium and beryllium is in accordance with the difference in chemical affinity of the three oxides.

H. BIENFAIT.

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Eindhoven.
Dec. 22.

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[1] NATURE, **144**, 510 (1939).

The Primus Stove at High Altitudes

THE risk of carbon monoxide poisoning from Primus stoves, discussed by Prof. Yandell Henderson and Mr. J. McCullough Turner in NATURE of January 20, was realized at least eighteen years ago. The Mount Everest party of 1922 was warned about this, on Prof. Georges Dreyer's advice. He pointed out how the danger might be aggravated at high altitudes owing to oxygen scarcity, and consequently less complete combustion.

Further, the late Mr. R. P. Hope has pointed out that to melt snow quickly a little should be melted to start with, so as to get some water in the pot before filling it up with snow. This seems plausible, because air in contact with the bottom of the pot must delay heat transmission, and when a pot is filled with snow to start with, the first water to form moistens the bulk of the snow rather than settles on the bottom.

As exploration is at least as popular at high altitudes as in the Arctic, the factors affecting snow melting high up may be of equal interest:

(1) The water vapour from the flame condenses on the cold bottom of the pot. The pot must be slightly tilted, so that the water drains away to its edge. Otherwise it drips on to the burner, decreasing the efficiency, and at times extinguishing the flame.

(2) The fuel efficiency of the ordinary mountain cooker, which has a plain wind screen in place of the annular container of the Nansen type, remains constant up to 15,000 feet, at all events. With the petrol Primus it is about 60 per cent, as against 80–90 given for the Nansen cooker, the figure of 60 applying to heating of water, and not melting snow.

(3) This particular type of Primus has been used up to 17,000 feet, but Mr. Rickmers reported that it then showed signs of not being far below its ceiling.

(4) The paraffin Primus, with roarer burner, fails at about 22,000 feet, owing to cooling of the vaporizer, due to the gas having to rise above its level before it finds enough oxygen for combustion. Shortly before the War of 1914–18, Dr. Kellas tried to climb Kamet, and failed to do so largely because he was relying on this kind of Primus for melting snow.

(5) The ordinary silent burner fails at about 26,000 feet, but when modified by enlargement of the holes through which air is admitted to the flame, it continues to function in vacuum chamber up to 31,000 feet. As it approaches this level the flame becomes greatly weakened and enlarged, and clouds of blue vapour get detached, and wander upwards in search of oxygen. This modification was due to Dr. G. M. B. Dobson.

(6) The ordinary Primus pump entirely fails high up, and starts to do so comparatively low down. The safety device against excessive pressure in the container is the large clearance given to the pump barrel, combined with a spring-controlled delivery valve which only opens under a pressure of about two atmospheres. At 15,000 feet air is taken in at about half an atmosphere. It has then to be compressed to about two atmospheres above container pressure before it starts to pass the delivery valve, and the valve closes as soon as the pressure in the clearance space falls to that amount. At higher altitude the pressure may fail to attain the intensity requisite to open the valve. The solution is the substitution of a large nut, specially shaped to fill the clearance space, for the small one at the end of the pump rod.

(7) The rate of combustion with fuels not burnt under pressure rapidly decreases with altitude. Thus, comparative tests made in 1927 at 15,000 feet on Monte Rosa and at sea-level, showed that Meta took twice as long to burn in the Meta Co.'s burner at the former level. With methylated in Messrs. Falk Stadelmann's Ideal burner there was a 22 per cent increase in time. As speed is an important factor when wanting a drink, and thirst is much increased with altitude, there is an advantage in the Primus, in that the rate of fuel consumption is independent of altitude, at all events up to 15,000 feet, and presumably above.

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Jan. 23.

Points from Foregoing Letters

J. C. Mottram finds that long exposure of Paramecium to the tumour-producing hydrocarbon 3 : 4-benzpyrene results in the production of a few abnormal individuals. If these are picked out and cultured in normal medium, populations of cells result, presenting wide morphological variation from apparently normal through varying degrees of abnormality to multicellular monsters. This state of abnormality was retained during reproduction through many generations. These populations resemble in many respects the assemblage of cells forming a cancerous tumour, where also wide morphological variation is found.

J. R. Loofbourow and Sister Cecilia Marie Dwyer, in continuing their investigations of the proliferation-promoting intercellular wound hormones produced by cells injured by various means, give evidence suggesting that disintegration of dead cells cannot account completely for these proliferation-promoting substances. Further support is given for the hypothesis that one response to injury of cells takes the form of release of proliferation-promoting substances into the surrounding medium.

A. F. Barker shows that the medulla of wool fibre on treatment with caustic potash breaks up into short lengths, each possibly representing a day's growth. Further work on the fibre of the under coat of the platypus shows this to have a ladder structure, each division representing about a day's growth. These observations raise further queries that need answering.

L. F. Bates and J. C. Weston describe measurements of the thermal changes accompanying the magnetization of a nickel rod in a step-by-step hysteresis cycle, when the rod is unstretched and also when it is under severe longitudinal tension. The measurements provide an excellent proof of Warburg's law, and show that 90° rotations of the Weiss domain vectors are not accompanied by measurable heat changes.

The fine structure of diffraction spots obtained from mica with convergent electron beams is explained by Carolina H. MacGillavry on the basis of the dynamical diffraction theory. From the distances between successive minima the structure factor of the reflecting lattice plane can be computed in a very simple way.

RESEARCH ITEMS

Nomad Gypsies of Hungary

BIRTH, marriage, death, are the central incidents of gypsy life in the Sárrét of Hungary, as described by Istvan Nagy of Budapest (*J. Gypsy Lore Soc.*, Ser. 3, 19, 1–2; 1940). The Sárrét, a territory of mighty morasses at the eastern end of the great Hungarian plain, which did not begin to be drained until the middle of the nineteenth century, was peculiarly adapted to their nomadic life; but social and economic circumstances forced them to settle in the villages at the beginning of the present century. Some still tend, however, to move from village to village. The Nomad or Tent gypsies were divided into tribes (now obsolete) and clans, with a head of the tribe and head of the clan, offices which have become mere titles without power. The names of the clans are derived from trades or from famous forebears, for example, the *Kolompára* clan (bell-founders) and the *Simonado* clan, so called from a famous ancestor. Some names are totemic, as the *Makara* or 'fish' family and the *Tsarneštyi* or 'fowl' family. Each clan had its specific trade and characteristics. The *Patrinara* clan are horse dealers, a distinguished, proud people of deservedly high repute. The gypsies are very prolific. Ten to twelve children in a family are quite common and sometimes there may be so many as sixteen or eighteen. Marriage is by elopement; consent of the parents is given and the marriage feast held after the return from the unofficial honeymoon. It may also be a child marriage contracted by the parents, when the two fathers enter into a binding contract kneeling before a lighted candle. The bridegroom, often not six years old, leads the bride, aged about four years, to his father's house and they grow up together. Formerly, marriage was matrilocal, the man sometimes even changing his name, but now marriage is patrilocal, owing to the influence of Hungarian laws. Divorce was easy, and no great importance was attached to virginity. The death ritual shows the double influence of the desire to be free of the dead person and his spirit, and the celebration of a joyous occasion. Hence on one side the dedication of personal possessions and gifts to the dead, on the other the wake or funeral feast at which the young people are permitted considerable sexual freedom.

Cultural Change Among Shoshoni Indians

THE importance of human ecology among hunting and gathering peoples is emphasized by Julian H. Steward in a study of changes in Shoshonian Indian culture in the western United States (*Sci. Monthly*, 49, 6; December 1939). When Frémont crossed the Rocky Mountains in 1843 he recorded that the Indians of the semi-arid deserts exemplified humanity in its lowest form and its most elementary state. These Indians were Western Shoshoni, Northern Paiute and Southern Paiute, who lived as typical food-gatherers, "dispersed in single families, without fire-arms; eating seeds and insects; digging roots". The mode of life of the Northern Shoshoni of eastern Idaho and western Wyoming, however, was in marked contrast. They were organized in large bands, hunted bison and fought their traditional enemies, the Blackfoot and Arapaho. This difference was brought about by an interaction of culture and environment which can be traced for over a thousand years. The Northern Shoshoni acquired the techniques for procuring food which made life possible in their environment, while the acquisition of the horse enabled them to exploit it to the full. Owing to the enlarged facilities in transport, food could be concentrated at a central point; and hence it was no longer necessary to live in small isolated family groups. Tribal groups were formed under chiefs or leaders, whose individual reputation might lead to the aggregation of large but not necessarily stable or long-enduring bands. Communal hunting expeditions with or without a hunting 'shaman', according to the nature of the game, were organized on a large scale and extending to considerable distances; while warlike activities for material gain or fame were practised. There was a no less fundamental change in material culture. Not only did they adopt arms and weapons suitable for warfare and hunting, but also the skin *tipi* took the place of the brush and pole shelter, and basketry for containers and utensils was replaced by rawhide, while their clothing was of dressed skins.

Bantu Lexicography

IN view of encouragement now being given to the development of a literature in certain of the Bantu languages, it is essential, the Rev. C. M. Doke has pointed out, that serious thought should be given to the provision of adequate linguistic studies including dictionaries (*Scientia*, 34, 1; 1940). After a review of existing material, the following principles of Bantu lexicography are suggested as among the essentials. (1) Alphabetical entry under the stem, without the prefix. (2) Derivative words should not have a separate entry, unless they have a special meaning not deducible from the plain function of their derivative formation. (3) Indications of the tone should be given, so far as possible, in all entries for those languages in which intonation is a significant feature. (4) Indication of the vowel-length should be given, especially in those Central Bantu languages where it is a semantic feature. (5) Phone values should be indicated where orthography is insufficient. (6) Idiomatic illustrations of the use of words should be included—of the utmost importance in any scientific dictionary. (7) Where dialectal variants are included the place of origin should be indicated. (8) Cognizance should be taken of a changing vocabulary. (9) Etymological and comparative material should be included so far as it can be afforded.

Orchis Tubercles

STUDY of the development of the tubercle of *Orchis mascula* I (B. C. Sharman, *J. Linn. Soc.*, 52; 1939) directs attention again to the peculiar capacity for growth possessed by localized parts of leaves and internodes in certain monocotyledons. In Orchis the uppermost axillary bud is carried away from the parent axis by the extension of the first two scale leaves of the axillary bud to form the sinker tube.

This extending tube includes, on the side next the parent, axial tissues of the region of bud insertion. This construction is supported by anatomy, since the vascular strands of the foliar structures enclosing the tubercle bud run up the adaxial side of the sinker tube to connect with the vascular system of the parent axis. The main storage region of the tubercle is of the nature of a root, but is peculiar in being polystelic. This peculiarity is evidently associated with food storage, since after the period of swelling the distal part becomes monostelic. The tuberization of the bud is controlled by food supplies and may also be affected by fungal infection. The droppers of tulips are very similar but usually undergo greater extension and show less evidence of food storage.

Calculation of Linkage

THE estimation of the crossing-over value is efficiently determined by the method of the product ratio (Fisher and Balmukand, 1928). To save much calculation of the ratio of the products of the cross-over classes to the products of the non-crossover classes in the F_2, W. L. Stevens (*J. Gen.*, 39, 171–180 ; 1939) has provided tables for direct interpolation, from which the crossing-over value, accurate to the fifth decimal, may be obtained, together with the variance of the crossing-over value.

Mineral Deposits of the Murchison Range

IN the eastern Transvaal a belt of basement rocks stretches from the escarpment in the west to the Kruger National Park in the east. Certain quartzites in this belt form a series of hill-ranges to which the name 'Murchison Range' is given. In a memoir of the Geological Survey of South Africa just published (No. 36, 1939, pp. 163 and coloured geological map) the mineral deposits of the belt are described by van Eeden, Kent, Brandt and Partridge. An igneous complex, hitherto unsuspected, is described as consisting of hornblende-granite and a variety of gabbroic types. The remainder of the Murchison rocks are shown to be intensely altered acid and basic lavas with an intercalated group of sediments in which occur the quartzites and quartz-schists that have determined the topography and controlled the mineralization of the belt. The whole schist belt, including the igneous complex, is invaded by the surrounding 'Old' granite, and the gold-bearing sulphide deposits of the belt are ascribed to hydrothermal processes related to the granite. The mineralization is predominantly of the arsenopyrite-pyrite-pyrrhotite type, except along a crush-zone, thirty-two miles long, known as the 'Antimony line'. Here, in addition to the normal minerals, a later suite of antimony minerals is also present. A number of minerals, of which emeralds are the most important, are associated with pegmatites. The emeralds occur in biotite-schists adjacent to pegmatites. Among the later rocks attention is directed to the exceptional abundance of dolerite dykes of Karroo age which cut the granite and schist belt and occur in two well-defined sets, one parallel to the range (N. 55° E.), the other trending N. 30° E.

Seismological Data from India

THE recently inaugurated quarterly seismological bulletin of the Government of India Meteorological Department has just been received for the quarter October–December 1938. It has been published under the direction of Dr. S. K. Banerji and consists of the interpretations of seismograms obtained at Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad and Kodaikanal, all collected at Bombay, together with non-instrumental reports collected from voluntary observers by the meteorologist at Poona. The following numbers of earthquakes were registered : Agra 133, Colaba (Bombay) 103, Alipore (Calcutta) 115, Colombo 71, Dehra Dun 32, Nizamiah Observatory (Hyderabad) 72, and Kodaikanal 76. These numbers are probably not altogether indicative of the seismicity of the areas adjacent to the observatories named on account of the variation of the registering equipment. Eleven earthquakes between the intensities 4 and 6 (Rossi–Forel scale) were recorded by the observers, those of greatest intensity being one at Gauhati, two at Dibrugarh and one at Kalat.

Tsunamis

THIS is the subject of a paper by B. Gutenberg (*Bull. Seis. Soc. Amer.*, 29, No. 4, 517–526 ; October 1939) who cites eighteen publications including some due to F. Montessus de Ballore, C. Davison and A. Imamura, and exhibits some original work of his own on the Atacama earthquake of November 11, 1922, in support of his hypothesis. This is that tsunamis ('tidal waves', 'maremotos') may be produced by submarine volcanic eruptions, submarine slides started by earthquakes, submarine faulting and atmospheric conditions. At least some of the largest tsunamis have been produced by submarine slides, with earthquake waves as a trigger force. The macroseismic and microseismic data of the Atacama earthquake of November 11, 1922, indicate that the fault movement occurred inland ; the tsunamis originated from a submarine slide near a relatively feebly shaken stretch of the coast where the surface slopes steeply to a considerable depth. On gently sloping coasts, such as those of California, large tsunamis are rare and the relatively small tsunamis there are probably produced by faulting at the bottom of the ocean.

Hydrolysis of Proteins by Pepsin

LIGHT on the mechanism of hydrolysis of egg albumin by pepsin has been shed by A. Tiselius and I.-B. Eriksson-Quensel (*Biochem. J.*, 33, 1752 ; 1939) using electrophoresis, sedimentation and diffusion methods. A digestion mixture does not contain a number of products of continuously varying size and other properties but instead contains only unchanged large molecules and fully digested end products of molecular weight 1080. Pepsin is therefore assumed to attack one after the other of the protein molecules, breaking them down immediately to low molecular weight split products.

Formation of Urea

THE accepted theories accounting for the formation of urea in the organism, namely, (1) the cyclic reaction from ornithine via citrulline and arginine to urea and thus back to ornithine, and (2) urea from glutamine and ammonia, are linked up by S. J. Bach (*Biochem. J.*, 33, 1833 ; 1939) who, from results of experiments on liver by the tissue slice technique, puts forward two other possible mechanisms. These are : (3) urea synthesis from citrulline by oxidative hydrolysis ; and (4) the possible oxidative conversion of ornithine and citrulline into glutamic acid and then glutamine and finally urea by the action of ammonia.

LONG-DISTANCE BROADCASTING

DURING the earliest years of the development of radio broadcasting in Great Britain, efforts were made to restrict the area over which reception was necessary, in order to build up a service giving speech and music reproduction of the highest quality. It was with this object in mind that the regional scheme of broadcasting stations was developed. The country was divided up into sections or regions, each of which was served by two transmitters, one providing the national programme and the other a local or regional programme. In this way the majority of listeners were provided with two programmes emanating from a broadcasting station within about one hundred miles, which was considered to be the limiting range at which a reliable service could be obtained free from interference or fading.

The possibilities of long-distance broadcasting on a considerable scale were not generally admitted until about 1932; but since then, many millions of pounds have been spent by the several countries which have decided to establish wireless stations for this purpose. A review of the general development of such long-distance broadcasting was given by Sir Noel Ashbridge, Controller of Engineering of the British Broadcasting Corporation, in a Friday evening discourse at the Royal Institution on January 26.

After summarizing very briefly the main facts accompanying the development of radio communication over hundreds and thousands of miles, Sir Noel pointed out that the short wave-lengths in the region of fifty metres offer the best possibilities of covering long distances, by reason of the comparative ease with which such radio waves travel through the ionosphere. There are, however, many disadvantages and complications with short-wave transmission, which are not encountered in the use of medium waves over moderate distances. For example, in order to attain anything in the nature of a reliable service, it is practically necessary to choose a special wave-length for each transmission, depending upon the geographical location of the sending and receiving stations, the time of day and season of year and the degree of sunspot activity on the surface of the sun.

Two advantages of the use of short wave-lengths are, first, that much less power is required to cover a given distance on account of the comparative ease of transmission through the ionosphere; and secondly, it is practicable to design antenna arrays and reflectors so as to concentrate the radiated energy into a sector or zone in the desired direction. The difference in local time must be taken into account when considering the areas where reception is required, so that it is not normally necessary to transmit in all directions simultaneously.

It will thus be realized that the only really practicable means of giving a broadcasting service to any distant continent is by means of short-wave transmitters using directional aerials, so designed as to cover by zones the countries to be served. These zones can then be supplied with programmes simultaneously, by using several transmitters together, or successively for shorter periods, using one or more transmitters which can be changed over from one directional aerial system to another at suitable times. Provision must also be made for changes of wave-length to conform to the varying conditions of light and darkness, season and state of solar activity. It will be realized that in order to arrange for reception during the evening in all parts of the Empire, it is necessary to transmit almost continuously throughout the twenty-four hours.

After experimenting with a single transmitter as far back as 1927, the Daventry short-wave station was opened for service in December 1932, with two transmitters of 10–15 kilowatts in power, and five antenna systems directed towards Australia, India, South Africa, West Africa and Canada respectively. The width of beam varied with the direction of transmission, and provision was made for the necessary changes of wave-length in each case.

In order to develop the service to the greatest extent possible, systematic experimental work was conducted by the B.B.C. with the view of improving the aerial systems, and in addition the co-operation of manufacturers was obtained to develop transmitters of considerably higher power than any hitherto available for short-wave radio communication. The first improvement included the substitution of horizontal aerials for the vertical dipoles previously used, and also the arrangement of the whole antenna system with its reflector to project the radiation at a small angle above the horizontal so as to give the efficient reflection from the ionosphere in the desired direction.

At the Daventry station, as it existed before the War, about thirty separate antenna arrays were provided, supported from twelve masts 500 ft. to 150 ft. in height, the whole covering a site area of about 160 acres. Additional transmitters with outputs varying from 50 to 100 kilowatts were also installed, and facilities are available for further additions. During this expansion and development, the introduction of foreign language broadcasting changed the character of the service somewhat, in so far as it became necessary to cater for world coverage instead of British Empire coverage only.

As a result of improvements on the above lines, a broadcasting service has been established on a permanent basis, giving large numbers of people great benefit by direct listening on short-wave broadcasting receivers. In addition, however, the efficiency of the service has been increased in many colonies by the establishment of local relaying facilities, in which the signals from England are received on a high quality and somewhat elaborate central receiver, and relayed either by a separate medium wave broadcasting transmitter, or by line to subscribers connected to a central exchange.

From the engineering point of view, the main development described in Sir Noel's discourse has taken place in the astonishingly short period of five years. It has been based on many years research by some of the world's most eminent scientific workers, followed by much patient work by engineers; and it is a matter of regret that temporarily many of the short-wave broadcasting services of the world have been directed to matters of international politics rather than to entertainment and the more peaceful type of informative programme for which they were intended.

R. L. S-R.

A NOTABLE METEOR

ON March 24, 1935, a bright meteor fell through the atmosphere, in a direction apparently not far from the vertical, over the Cheviots in Northumberland, about twenty miles south of Berwick. The day was a Sunday and at the time, about 7 p.m. (G.M.T.), night was beginning to fall over England. Probably because the sky was still too light, the meteor seems to have almost escaped notice in England: one observation is reported from Scarborough, and several adults and children saw it from Oldham, falling down as a vivid shooting star with a flaming tail. From Holland, Denmark and southern Norway, however, where the twilight was almost ended, many observers saw either the meteor itself, or the bright train which it left behind it; this persisted for 20–30 minutes. Prof. C. Störmer (*Astrophysica Norvegica*, 5, 117–138; 1939), naturally with much help from others, has collected and discussed the observations, in order to determine the location of the meteor flight, and the height and other particulars concerning its train. At first, of course, the train was straight, but it gradually became very deformed; this was possibly partly on account of its sinking downwards, but mainly because of air currents, almost horizontal, but evidently varying very much in direction at different heights along the original train. The rare cases, such as this, of persistent luminous trains of large meteors, provide one of our chief sources of information concerning the velocity and direction of the wind in the atmosphere above 70 km., the other sources being the still rarer luminous night clouds, and the infrequent remains of polar auroras.

The most definite data obtained by Prof. Störmer for the meteor of March 24, 1935, were provided from a photograph of the train, already much distorted, taken at Grouw, in Friesland, at about 7.10 p.m., and three pastel sketches (in colours) of the distorted train, made at 7.0, 7.10 and 7.20 p.m.; these were made from a house in Stavanger, Norway. These sketches and the photograph were of special value because they showed an indented skyline (landscape or buildings) which enabled the azimuth of the meteor from Stavanger and Grouw to be determined afterwards (though with considerable labour). Other photographs showed the train as a spectacle, but contained no means of determining its azimuth so definitely.

The points Stavanger and Grouw together with the meteor train itself made an almost equilateral triangle of approximately 400 miles side. Yet from that distance the twisted trail as seen from Stavanger shone against the sky background with sharp outlines, and had the same colour and intensity as the moon. The light was steady, like electric light, and did not at all resemble the northern lights. It became increasingly distorted and at the same time it broadened and faded. By 7.30 p.m. (G.M.T.) it had entirely disappeared. It seemed to remain in the same spot all the time.

Prof. Störmer found that the top and bottom of the train were respectively about 60 and 50 miles above the ground, and that until about 7.30 p.m. it lay above the earth's shadow, so that it was illuminated by the sunlight; he concludes that the intense yellow colour of the train was due to this illumination.

As regards the meteor itself, it appears to have descended to a height of about 40 miles or less, and finally exploded with an intensely white light: the lowest part of its trail disappeared almost instantaneously. The meteor was said to have moved slowly like a rocket, its time of passage being about 5 seconds. As regards the colour of the train, one report gives it as fiery-red, another as red-yellow.

Prof. Störmer's discussion of this meteor and train is illustrated by plates showing the sketches and photographs.

ANCIENT WALL-PAINTING IN SOUTHERN INDIA

AN investigation has been conducted by S. Paramasivan, archæological chemist of the Government Museum, Madras, with the view of determining the technical methods employed in the wall paintings of the Kailasanatha and Vaikunthaperumal temples of Conjeevaram, the ancient Pallava capital, and in the Bagh caves of the Vindhya Hills, Gwalior State. The last named paintings, though much mutilated and stained, still constitute "a priceless treasure comparable to those at Ajanta" (*Proc. Ind. Acad. Sci.*, 10, Section A, No. 2; 1939. See also NATURE, 142, 757 and 143, 554).

KAILASANATHA AND VAIKUNṬHAPERUMAL TEMPLE PAINTINGS

The Kailasanatha paintings date from the seventh–eighth centuries A.D., and are on the inner walls of narrow cells lining the outer courtyard, depicting scenes from Hindu mythology. Those of the Vaikunṭhaperumal temple, erected by Nandivarman II (A.D. 725–790), probably date from the eighth–ninth century. They have all disappeared with the exception of a single head; but there are traces of paint everywhere.

The Pallava paintings are of the classical or Ajanta style of Hindu art. The subjects of the investigation were the carrier, the ground, the pigments and the binding medium.

Carrier. The inner walls serving as the mechanical foundation of the paintings directly supporting the ground are of sandstone, the rough surface holding the plaster fast.

Ground. Microsections showed two lines of cleavage separating three layers, (1) rough plaster, (2) fine plaster, (3) paint. Though paint and fine plaster could be separated with a sharp pin, no separation could be effected between fine and rough plaster. The respective thicknesses were: painted stucco, 2·1–4·7 mm.; rough plaster, 1·5–4·1 mm.; fine plaster, 0·3 mm.; paint, 0·3 mm.

By analysis it was determined that the fine plaster is a lime-wash, while the rough plaster is composed of lime and sand, the latter serving merely as inert material. A pure rich lime having no hydraulic properties has been used. No organic binding material, gum or glue, had been added. The strong binding of the two layers indicated that the lime-wash had been laid on while the rough plaster was still wet.

Pigments. These were yellow ochre, red ochre, terre verte, carbon, lime—the limited number being due probably to the desirability of avoiding pigments containing alkalis, and secondly, the limitations of local supply.

Binding Medium. There was no water-soluble binding medium nor drying oil, glue, albumin or casein in the paint. The technique is one of lime medium, but owing to the nature of the pigment, gum had been added to the black.

THE BAGH CAVES

Owing to the weight of the superimposed band of claystone, the walls of the sandstone caves, once completely covered with paintings, have crumbled badly. Percolating moisture has also damaged the paintings. They probably date from the early seventh century A.D. Like the Ajanta paintings they belong to the Golden Age of Indian classical art.

Carrier. The sandstone walls were left rough to hold the plaster wall; but the percolation of water has softened the plaster, while the white efflorescence on several of the paintings indicates the presence of gypsum, sodium sulphate, magnesium sulphate, etc. This efflorescence is not due to salts in the plaster, as is clearly indicated by analysis.

Ground. Three forms of plaster were used: a deep red ferruginous earth, a light red ferruginous earth, and a rough plaster of lime. Microsections here revealed three lines of cleavage in the earth stuccoes, and two in the lime, indicating four and three layers respectively. They were composed of paint, a white material serving as fine plaster, and two layers of rough plaster in the earth stucco, but one only in the lime stucco. The thicknesses were as follows. Earth stuccoes: rough plaster (1) 6·8–19·9 mm., (2) 1·0 mm.; fine plaster, 0·1 mm.; paint, 0·1 mm.; lime stucco: rough plaster, 3·4–6·5 mm.; fine plaster, 0·2 mm.; paint, 0·2 mm. The earth stuccoes are very much thicker than those of lime, while the paint film in the latter is twice as thick as that on the earth stucco and shows a certain lack of delicacy in the handling of the brush. It is probable, therefore, that the lime stucco does not belong to the palmy days of Bagh, or that the paintings on lime and earth stuccoes were the work of different groups of artists.

The fine plaster was a mixture of lime and calcium sulphate which had been applied to the surface of the rough plaster to serve as a fine plaster; but in the lime stucco the fine plaster showed no trace of calcium sulphate.

Thus the ground was prepared from naturally occurring ferruginous earth, or of artificially prepared lime plaster. The principal components of the earth plaster are silica, iron, alumina and lime, while of the lime plaster they are lime and silica. The plasters, in addition to their natural binding qualities, have been reinforced by vegetable fibres in the lime plaster in considerable quantities.

Pigments. The following pigments were identified: yellow ochre, red ochre, terre verte, lapis lazuli, carbon, lime. The colour scale is limited and evidently conditioned by local supplies.

Binding medium. No gum could be extracted by water, nor was the presence of any vehicle or organic binding medium in the paint film detected by various tests applied; but acid green indicated the presence of glue. Thus a tempera technique had been employed; but on all the paintings on plaster collected, treatment with hydrochloric acid gave a characteristic calcium reaction indicating a lime medium technique, and not a true fresco technique. The black paint gave the usual stain for glue to acid green.

THE BRITISH PHARMACOPŒIA

PROPOSED INNOVATIONS

IMPORTANT changes in the "British Pharmacopœia" are foreshadowed by reports of committees, appointed by the Pharmacopœia Commission, which have now been published by authority of the General Medical Council and are obtainable at the offices of the Council, 44 Hallam Street, London, W.1.

The most striking of the recommendations of the Advisory Committee in Pharmacy and Pharmacognosy are those which propose the inclusion in the next "Pharmacopœia", due to appear in 1941, of a large number of formulæ for medicinal preparations. These are quite distinct from the galenical products, such as tinctures, extracts and infusions of vegetable drugs, which always occupy an important part of pharmacopœias and from which medical practitioners build up their prescriptions. The object of the inclusion of these formulæ is to furnish medical practitioners with a choice of ready-made prescriptions which have been tested by laboratory and clinical experience. Prescriptions are included for compound digitalis pills, compound bismuth powder, cod liver oil emulsion, methyl salicylate liniment, calamine lotion, tannic acid jelly, acriflavine lotion and calcium gluconate injection, among some thirty proposed new monographs of the character of ready-to-use medicines.

It is understood that the Pharmacopœia Commission regards this innovation favourably, and there is no doubt that it is one which would be welcomed by the large body of general practitioners. The inclusion of these recipes in the "Pharmacopœia" would set up official standards with which the preparations would have to comply; thus a doctor prescribing, say, "Pulv. Bismuthi Co. B.P.", would have the satisfaction of knowing that the medicine supplied to his patient would be the same, wherever it was dispensed.

The Committee which was appointed to advise the Pharmacopœia Commission on the standardization of tablets has not as yet reached conclusions. Its report states that the possibility of defining tablets in the "British Pharmacopœia" has been explored and the general principles to be adopted have been worked out, but while good progress has been made towards the establishment of standards for composition, size and weight of a range of tablets in frequent use and the question of a test for disintegration has been investigated, further research is necessary before definite recommendations can be made. It is hoped, and expected, that an acceptable test for the rate of disintegration of tablets will be forthcoming before the next "Pharmacopœia" goes to press ; the need for one was clearly shown in papers read at the last meeting of the British Pharmaceutical Conference.

A curious recommendation is made to the Pharmacopœia Commission by the Committee on Pharmacy and Pharmacognosy as a test for the pungency of tincture of capsicum. It is that 3 millilitres of a solution of stated dilution "swallowed all at once produces a distinct sensation of pungency in the throats of at least two out of three individuals". Possibly the criticism will be made that this is more like a test for throats than a test for capsicum.

PETROLOGY OF EAST GREENLAND

By Dr. L. Hawkes
Bedford College, London

THIRTY years ago it might have been thought that the main forms of intrusive bodies in the North Atlantic Tertiary volcanic province were known. Then came the discovery by the Geological Survey of the cone-sheet and ring-dyke complexes, and now in a part of East Greenland very difficult of access Mr. L. R. Wager has had the good fortune to find, and, in association with Dr. W. A. Deer, the pluck and persistence to investigate, an intrusive mass which in form, composition and internal structure is unlike any hitherto known in the province. The work in the field and laboratory has been very thorough, and the results are now presented in a handsomely produced memoir which will be of absorbing interest to students of igneous rocks and doubtless a basis of lively discussion among them*.

The Skaergaard intrusive is finely exposed in a mountainous region, but as is so commonly the case with large intrusives, the original rock cover has been removed by erosion and the base is not seen. The mass narrows downwards and the 2,700 metres of its exposed thickness is interpreted as the upper part of an inverted cone some seven kilometres in diameter at its base and tilted 40° from the vertical—it belongs to the class of 'funnel intrusions'. The pre-existing rock displaced by the intrusion must have been forced upwards, and that without appreciable disturbance of the neighbouring rock. The authors suggest that the expulsion of this huge mass was a sudden act, and that the cover was shattered by expanding gases and strewn far and wide. Rather mysterious is the way in which an extensive gabbro sill, believed to have been enclosed within the cover, has become disembodied, to lie within the intrusive. Whatever the mechanism of emplacement, there came into being within the upper part of the earth's crust a volume of magma enclosed—to use Prof. Tilley's apt phrase—in a gigantic natural closed crucible, and the cooling of this perhaps unusually fluid melt proceeding under tranquil conditions has provided a remarkable demonstration of the course of differentiation in a basic magma.

Solidification first took place at the sides and top of the 'crucible' and then, more slowly, crystallization continued in the main mass within to give a series of rock layers likened to a pile of saucers, many of the layers being distinguished by a preponderance of dark minerals at their bases. This layering is so prominent that on first seeing the Skaergaard region from a ship, Mr. Wager surmised the rocks to be massively bedded sandstones. Any hypothesis of successive intrusion seems to be ruled out, and the solid mass is believed to have grown from below upwards, largely by accumulation of crystals carried down by convection currents. This postulated upward course of solidification is strongly supported by the nature of the minerals : with increasing height in the intrusive, the olivines, pyroxenes and felspars show a gradual passage from higher to lower temperature species.

The original magma, as deduced from the chilled border rocks, was of basaltic composition, and very little change in silica content is shown by the majority of the successive rocks formed, but they become unusually rich in ferrous iron, and ferro-gabbros are described composed essentially of pyroxene, plagioclase, fayalite and some quartz. Then finally and abruptly a relatively small amount of acid granophyre resulted. Notwithstanding the extreme rarity in the earth's crust of rocks of ferro-gabbro composition, the authors hold that the course of differentiation here followed is the normal one for a basic magma. But the 'crucible' was not a platinum one. Its lower part was of acid gneiss, and the magma has reacted with inclusions of granophyre. These inclusions are considered to be altered gneiss, although—somewhat strangely perhaps—the passage of gneiss to granophyre seems not to have been observed either in the wall rocks or in the inclusions. To this 'contamination' of the magma the emergence of part at least of the final acid granophyre differentiate is ascribed, and the authors subscribe to the view, now steadily gaining ground, that the normal calc–alkaline series of igneous rocks is not derived from the straightforward differentiation of a basic magma but results from the incorporation within that magma of acidic material. If this is accepted, the large granophyre intrusions of Skye and elsewhere in the province must owe their origin to the fusion of acid gneiss or crustal sialic rocks of like composition : this, however, is still a controversial matter.

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* Geological Investigations in East Greenland, Part 3. The Petrology of the Skaergaard Intrusion, Kangerdlugssuag, East Greenland. By L. R. Wager and W. A. Deer. *Meddelelser om Grønland*, **105**, Nr. 4.

SEVENTY YEARS AGO

NATURE, vol. 1, February 3, 1870

Catching Cold

PROF. SYMES THOMPSON, Gresham professor of medicine, in one of his Gresham lectures discussed the cause of the common cold. After describing the cavities concerned, he pointed out that "the ordinary cold is simply, in the first instance, congestion of the warm, moist, blood-charged membrane, which lines all these cavities and is continuous throughout the series of them. . . . This congestion is apt to pass on, under unfavourable circumstances, to inflammation, and to consequent derangement of structure. The congestion merely means that more blood is thrust upon, and retained in, the minute channels and vessels of the membrane, than those channels can healthily accommodate. The first cause of this forced engorgement is that cold is extensively applied to the internal skin, which then, under the constringing and contracting influence, drives its own blood out, partly into these surcharged tracts of mucous membrane. The injurious effect known as 'cold' is now sure to be realised if this external chill is experienced when the general system is weakened by exhaustion."

Once a cold has been "caught", Prof. Thompson says that vigorous circulation of the blood in the skin should be restored, preferably by a Turkish bath, "reinforced by the administration of stimulants, first and foremost amongst which stands concentrated food. Indeed, the Professor's pet stimulant seems to be 'Whitehead's Solid Essence of Beef'. . . . This preparation differs from Liebig's Extract of Meat chiefly in containing the gelatinous as well as the fibrinous constituents of the flesh. . . . The Gresham professor scattered the little round cakes, out of neat half-pound cases, liberally to his audience, recommending them to begin at once to fortify themselves against the inclement atmospheric influences".

Deep Mining for Coal

MR. EDWARD HULL, F.R.S., director of the Geological Survey of Ireland, read a paper before the Royal Society on the temperature of the strata taken during the sinking of the Rose Bridge Colliery, Wigan, in 1868–69. This mine was 808 yards deep, "is the deepest in the world" and the temperature at the bottom was 93½°. It may be regarded, it is said, as an experiment towards a solution of the question of very deep mining and has "an especial interest for those who concern themselves about our supplies of coal".

"IT is no secret that the present régime at the Observatory of Paris has been rather more autocratic than could be patiently endured, even in a country subjected to eighteen years of personal government. Matters have at length reached a crisis, and the Minister of Public Instruction is placed in the awkward position of having to dismiss from the public service one of the most eminent of modern astronomers, or accept the resignation of the whole of the rest of the staff of the Observatory." [The Director was M. Le Verrier.]

BEFORE a meeting of the Berlin Chemical Society, Prof. Rose reported on the first diamond to be found in Europe. A small diamond had recently been found in Bohemia, in which garnets, hyacinths and sapphires had been found for years.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PART-TIME SPEECH THERAPIST in the Psychiatric and Child Guidance Clinic—The Secretary-Superintendent, Addenbrooke's Hospital, Cambridge (February 10).

A LECTURER and a SENIOR LECTURER in the Department of Mathematics in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (March 1).

ENGINEER for the Public Works Department of the Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/8993).

TEMPORARY METEOROLOGICAL ASSISTANTS (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

EXAMINERS in the General Engineering and W/T and Instrument Branches of the Aeronautical Inspection Directorate—The Inspector-in-Charge, A.I.D. Training School (I.C.S./Rec.52), Brandon Steep, Bristol 1 (on Form 786).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Manchester Museum: The University of Manchester. Museum Publication 116: Report of the Museum Committee for the Year 1938–39. Pp. 32. (Manchester: Manchester Museum.) 6*d*. net. [111

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Sixteenth Conference organised to be held at Nottingham University College, September 15th to 18th, 1939. Pp. 92. (London: Association of Special Libraries and Information Bureaux.) 5*s*. [161

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1938; with Report and Notes of the Director, Rev. J. P. Rowland. Pp. xix+40. (Blackburn: Stonyhurst College Observatory.) [161

The *Chemist and Druggist* Year-Book, 1940. Pp. 355+Diary. (London: The *Chemist and Druggist*.) [161

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 2: Cyclic Variations in the Vascular Architecture of the Uterus of the Guinea Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 79–86+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 9*d*. [181

A List of Books suitable for a School Science Library. Pp. 88. (London: Science Masters' Association.) 1*s*. 2*d*. [221

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par Sir D'Arcy Wentworth Thompson. Vol. 27, pour l'année 1937. Pp. xxxiv+50. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr. [101

Bulletin of the Bingham Oceanographic Collection. Vol. 6, Art. 7: Quantitative Observations on the Pelagic Sargassum Vegetation of the Western North Atlantic, with Preliminary Discussion of Morphology and Relationships. By Albert Eide Parr. Pp. 94. Vol. 7, Art. 1: Acoel and Polyclad Turbellaria from Bermuda and the Sargassum. By Libbie H. Hyman. Pp. 26+9 plates. Vol. 7, Art. 2: Young Caranx in the Western North Atlantic. By J. T. Nichols. Pp. 10. (New Haven, Conn.: Yale University.) [161

U. S. Department of Agriculture. Circular No. 530: The Vegetable Weevil. By M. M. High. Pp. 26. 5 cents. Leaflet No. 192: Centipedes and Millipedes in the House. By E. A. Back. Pp. 6. 5 cents. (Washington, D.C.: Government Printing Office.) [161

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PRESENT-DAY PROBLEMS OF YOUTH

SOME weeks ago, the National Youth Committee set up by the Board of Education announced that the Government had no intention of allowing a recurrence of the social problems of the War of 1914–18. Despite this assurance, familiar youth problems have again presented themselves and new ones have been created. A number of these were probably inevitable; others could probably have been avoided. It is not easy to resist the conclusion that, in certain important matters, the Government departments concerned with the social services have shown themselves to be regrettably lacking in foresight.

Nor is it easy to resist the further conclusion that some of them are exhibiting very little alacrity, method or determination in dealing with problems which appear to many to be urgent. Doubt on this point may be permissible, for it is probable that their hands are being tied by the Treasury, through reduction in financial assistance. But it might not have arisen at all, if these departments had shown more frankness in their pronouncements. Nothing is more likely to stiffen the task of the Director of Home Publicity at the Ministry of Information—that of making public opinion receptive to political decisions—than an accumulation of unanswered or half-answered queries on such matters.

If bewilderment is produced in this way, further psychological difficulties are created. In some cases, formidable resentment is built up; in others, apathy becomes all-pervasive. During recent weeks, both these reactions have been exhibited plainly; and nowhere more clearly than among those concerned directly and indirectly with problems of juvenile employment. In their treatment of a number of these problems, some departments seem lately to have displayed neither frankness nor wisdom.

Why, for example, has the Home Office had to undertake to consider applications for exemption from those sections of the Factories Act of 1937 which regulate the hours of work of juveniles? Surely the evidence collected during the War of 1914–18 by the Health of Munition Workers' Committee suggested strongly that even the regulations of the Act of 1937 were not entirely adequate? It is not to be doubted that the factory inspectors of the Home Office will use their new powers with great discretion, but it is more than likely that some of them will feel compelled at times to declare decisions which they will reach with considerable reluctance. From various parts of the country it is already reported that two of the most evil consequences of unsuitable working hours—listlessness and loss of 'further education'—have once more manifested themselves. In his recent King George Jubilee Trust report, "The Needs of Youth", Dr. A. E. Morgan remarked, "British industry will not be ruined by being deprived of the privilege to exploit half-educated boys and girls". This pungent comment is as true in war-time as it is in times of peace. Even in factories which retain their pre-war time-tables, the *tempo* of production is apparently increased sometimes to such a pitch that the physical and psychological state of the slower workers is seriously affected.

Has the Home Office decided, in the face of all the evidence available on this subject, to surrender to the Ministry of Supply? If the outlook indicated by this ruling is maintained, what will be the quality of Britain's democracy at the end of the present conflict? For some workers, possibly even for the younger ones, patriotism may provide an additional incentive; but, as Dr. H. M. Vernon reminded his hearers at a meeting reported in NATURE of February 3, p. 174, "Nature cannot be defied indefinitely."

Again, why has the Ministry of Labour permitted the suspension of certain of the vocational guidance and after-care activities of its Juvenile Advisory Committees? Why has the Ministry's scheme for the transference of young workers apparently ceased to function, while the need for it continues? And why have some at least of its hostels for these boys and girls closed their doors? Even when allowance is made for difficulties created by evacuation, such actions are bound to perplex those who had been led to believe that the Ministry took a broad view of its responsibilities towards young people. It is perhaps significant that its war-time opinions on vocational guidance and after-care have not been accepted without question by other experts. Its advice has been ignored by many local education authorities who have juvenile employment officers of their own and in whose districts the Ministry is only in indirect command. The very fact that acute disagreement exists here suggests that the Ministry's case for curtailing its activities is by no means unarguable. The 'rebels' are unquestionably right in maintaining that, both from the point of view of the individual, who needs a congenial occupation if he is to exert himself fully, and from the point of view of the nation, which urgently requires efficient workers, sound vocational guidance is at least as necessary now as it was before the War. If the Ministry feels unable to continue this branch of its work, it might well ask local authorities whether they will take it over. The machinery for such a transfer already exists.

Furthermore, why have the Civil Service Commissioners had to suspend their normal examinations for entry to this Service? A very considerable number of able boys and girls—and their parents and teachers—have lately been profoundly disturbed by the Commissioners' unexplained move. In all parts of the country, secondary school principals, who are in a good position to judge the public reaction to it, are voicing strong criticisms of the Government's attitude to this problem. It is understood that alternative proposals, put forward by the staff side of the National Whitley Council, are being considered. Consideration of them should be completed speedily and positively. Purely negative decrees on employment matters by the Government can scarcely be held to provide good examples for private employers; nor can they easily produce the occupational incentives which are so much needed by young people at the present time.

Indeed, the negative character of the official attitude to many employment matters is extremely disconcerting. No reasonable person would expect the Government to show unerring foresight in making plans for dealing with situations which might never arise. But there is, unfortunately, much evidence which suggests a marked lack of constructive and co-ordinated thought. A striking example is to be found in the astonishing absence—an almost total absence—of official comment on what has been called the "16 to 20" problem.

Lord Derby has suggested that voluntary labour camps should be provided for boys of secondary education who fall within this age-range. His proposal has been discussed at length in the correspondence columns of *The Times*. It is doubtful whether the space devoted to it has been commensurate with the usefulness of the suggestions put forward, or, indeed, with their relevance; for most of them—not unnaturally, perhaps—have been concerned primarily with the comparatively limited problem of the boy whose parents have been able to send him to a public school. The Ministry of Labour's contribution to the discussion—communicated through *The Times* Labour Correspondent—has been a statement of the conditions under which boys in this age-group may be admitted to its ordinary technical training centres. Is it surprising that the head master of a large south of England secondary school reports that his boys are "simply bewildered" about their futures?

Could not the Ministry of Labour at least stress frankly the need for considering the post-War effects of such schemes as those proposed by Lord Derby and his supporters? They certainly need consideration; for many of the suggestions seem to have been based on false assumptions. One is that many boys in the 16–20 group have sufficient money and influence to enable them to make an entirely fresh occupational start after the War and therefore need not worry if, in the period prior to their military service, they are called on to do something which bears little relation either to their abilities or to their interests. Another is that, when the War is over, the national recovery will not be hindered by the presence in the community of large numbers of middle-class young men devoid of occupational training and experience suitable to their talents and temperaments. The vast majority of those leaving secondary schools cannot afford, even in war-time, to be ushered silently into unsuitable 'stop-gap' occupations; nor can the nation afford it. It is clearly important that these youths should be regarded, not as unfortunate liabilities to be put temporarily into places where they will create a minimum of trouble, but as citizens-in-training. The head master of Winchester College, who is chairman of the Head Masters' Conference, has very properly insisted that, in any work scheme produced for the 16–20's, the opportunities offered should be *real.*

Is it too late to suggest that this problem should be tackled experimentally by the Ministry and the Board of Education? Individual head masters here and there are doing this in their own way, and according to their own ideas: for example, by providing special commercial courses for senior boys who would normally have entered clerical occupations this year but have been unable to do so, and by increasing the amount of time devoted to O.T.C. activities. The Board of Education has already dealt with one of its own difficulties by allowing non-graduate students to enter its teachers' training colleges at the age of seventeen. The Y.M.C.A. has proposed the formation of a Boys' Land Army. A number of professional training organizations have begun to provide shortened courses of instruction. One well-known rubber company has announced its intention of awarding a certain number of 'scholarships', providing free training and maintenance grants, to boys between the ages of 17½ and 19. Could not these experiments be co-ordinated and extended? If this were done, a great deal of the resentment and apathy noticeable at present might rapidly be dissipated and much valuable data might be gathered. But it will have little worth if it be not done seriously and with a determination to act on the results obtained. The adoption of an experimental approach, which might well make use of psychological techniques of vocational guidance and selection, must not be made an excuse for shelving decisions by bestowing semi-official blessing and inadequate funds on ardent advocates of reform, in the hope that the problem will quickly lose its urgency by the absorption of young men into the Fighting Services. An appropriate first step would be the appointment, by the departments concerned, of a director of research.

SCIENCE FOR A NEW AUDIENCE

Science and Everyday Life
By Prof. J. B. S. Haldane. Pp. 284. (London: Lawrence and Wishart, Ltd., 1939.) 5*s.* net.

THOSE who subscribe to the *Daily Worker* are privileged to read every week some of the most successful expositions of popular science in contemporary journalism. It is not possible to discuss the implications of this fact in a brief review; but if Prof. Haldane's modesty would permit him to admit that he is both a first-class man of science and a first-class educator, his faith would make him insist that he would be neither were he not a first-class Marxist. This collection of articles is certainly as political as it is scientific, and its author would believe it less scientific if it were less political.

The book should be read not only by the general public but also by all those who aspire to make science intelligible to the general public. To these the author's technique will be a liberal—as well as a Marxist—education. Why is it so successful? Apart from the blustering, ozone-laden style through which Haldane introduces himself to his readers, rather as the *homme moyen sensuel* than as the ascetic scientist, there is the picture which he seems to carry in his eye of what his reader is like. He does not write for readers in their capacity of consumers willing to fill a leisure hour with science gossip, but rather as producers into whose labours science has already entered at every point. He creates a synthesis between the theories of scientists and the actions of workers, miners, chemical manufacturers, barmen, who are applied scientists by virtue of economic necessity. He does not describe disease as an abstraction but shows it always to be occupational, a function of the social environment.

Above all, the politician in him prevents Prof. Haldane from committing the commonest error of men of science trying to write for the man in the street, namely that emotion, or personal equation, is as deadly then as in the writing of a monograph for the *Philosophical Transactions*. He believes that the voice of honest indignation is the voice of science and so he writes.

Occasionally Prof. Haldane permits himself the luxury of statements that, taken at face value, could no doubt be challenged. For example, he says that "By postponing marriages, the Means Test not only causes unhappiness, but actual mental defect". It is improbable that Prof. Haldane could produce evidence that the means test has actually increased mongoloid imbecility, but then he would point out that the only sort of person likely to take him up on such a point would be "Reactionary biologists" some of whom think "that the unemployed should be sterilized".

Two passages especially suggest how far we have gone since the day when popular science catered chiefly for ladies who sought a change from fancy sewing. The first is where Prof. Haldane sums up against astrologers in Sunday papers: There is no righteous indignation; astrology is not an insult to that abstraction, scientific truth; "Astrologers and palmists are very useful to the cause of capitalism. They help to persuade people that their destinies are outside their control. . . . If enough people learn how the joint fate of us all can be altered, things begin to happen which mean the end of capitalism as well as of astrology and palmistry".

The other passage gives a significant criterion for judging between cause and cause. "We are quite right," Prof. Haldane points out, "to emphasize the environmental factors in tuberculosis just because we can control them. We say that a house caught fire because someone threw down a cigarette end, and not because there is 21 per cent of oxygen in the air". Implicit here is the doctrine that the duty of the scientist is not to explain the world but to alter the world, and implicit on every page of the book is the author's belief that his duty as an educator is not to help his readers simply to understand phenomena but to become the *primum mobile* of their evolution.

JOHN LANGDON-DAVIES.

CHEMISTRY OF ORGANIC COMPOUNDS

(1) Ausführliches Lehrbuch der organischen Chemie

Von Wilh. Schlenk. Band 2. Pp. xvii + 896. (Wien und Leipzig: Franz Deuticke, 1939.) 30 gold marks.

(2) The Chemistry of Organic Compounds

A Year's Course in Organic Chemistry. By Prof. James Bryant Conant. Revised with the assistance of Dr. Max Tishler. Pp. x + 658. (New York: The Macmillan Company, 1939.) 18*s*. net.

(3) Introduction to Practical Organic Chemistry

By Dr. Frederick George Mann and Dr. Bernard Charles Saunders. Pp. ix + 191. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 4*s*. 6*d*.

THE three books under review are so closely related to modern organic chemistry that they are conveniently taken together. They represent in a very marked manner the kind of organic chemistry which the young man of the present day, and perhaps for the next twenty-five years, will have to learn if he desires either to make the subject his life-study or intends to use it merely as a stepping stone to other walks of life.

(1) The reputation of Prof. Wilh. Schlenk as a writer and teacher was established when Vol. 1 of the text-book was published. The appearance of Vol. 2 enhances that reputation. To an earlier generation the two volumes must show a striking resemblance to that wonderful treatise started by Victor Meyer and Jacobson, the first volume of which appeared before Victor Meyer's death but which was finished later by Jacobson and others. It was the first volume that contained both knowledge and wisdom and showed that even a book on organic chemistry could be made readable and interesting to the lay mind. The book contained such a wealth of knowledge expressed in such beautiful phrasing that it is doubtful whether we shall ever see its like again.

Vol. 2 of Schlenk's book, in general treatment and in power of expression, follows, with Vol. 1, as commendable modern equivalents of the first volume of Meyer and Jacobson. Like Victor Meyer's book, it is no mere record of an endless number of compounds, but deals only with such substances or group of substances as lead to or enforce the establishment of some theoretical point of value in the discussion of some principle underlying the science. The discussions on these points are by a master mind and make excellent reading. They give the book an interest unusual in a scientific text-book. According to the short preface the author intends to publish a Vol. 3 to complete the issue. If the third volume is as good as the other two, the whole work will form a striking addition to our chemical literature. There is, of course, the difficulty of language for the English reader, a difficulty which is not overcome by a translation, if such were possible nowadays. The true charm of the book lies in the expression in the German language of the enthusiasm of a man who loves his subject and is prepared to give all he possesses in unstinted measure to those who can appreciate the gift. An English translation would be but a dead-sea apple and turn to dust and ashes in the mouth. It would be lifeless. Despite present circumstances, we must place a mastery of the German language in the forefront of our educational schedule. The Germans as scientific people rank high and we should be curiously handicapped if we failed to understand or to appreciate any new discovery they might make, the lack of a knowledge of which might stand us in ill-stead.

The free interchange of knowledge as it was say forty years ago, no longer exists. Many things have caused the change, notably the supposed need for commercial secrecy. It is true that many firms permit publication by their employees, provided all requirements of the patent laws have previously been met. This involves, usually, some little delay, but can scarcely be regarded as a hardship. Other firms, unfortunately, do not grant such privileges, and much useful and perhaps essential knowledge is buried in their archives. Team work in industry has come to stay because it is by far the best means of attacking a general problem, and although the team worker is individually the loser by sharing any new discovery with others, it is made up to him in other ways and the new discoveries can be published by the firm under the names of the team-workers concerned. For it is essential that new knowledge should be published, annotated and recorded, otherwise progress will be impossible. One can scarcely realize what the present position of knowledge would be had the research workers of the past evaded the path of free publication. Nevertheless, with good will and co-operation between industrialist and scientist, the terms being used merely to denote two different types of scientist, all will be possible and the goal reached by which all new knowledge will be annotated and pigeonholed for the benefit of succeeding generations.

Let us, for example, be certain that a book like Schlenk's is full and unrestricted and that nothing is held back either by reasons of commercial exigencies or for any cause whatever. It is surely in the interests of industry itself that there should be unrestricted publication of all new knowledge, for it is unthinkable that new knowledge can be discovered if any industry buries the information it has gained on account of some real or supposed desire to prevent a competitor from taking advantage of it. By burying its knowledge, a firm reaps no real benefit but injures itself by checking the advance of knowledge in other branches of the subject with which it deals. The research worker is thereby prevented from knowing what has been discovered, the progress of discovery is inhibited and the direction on which all true progress depends is lacking.

(2) President Conant is a great administrator, and his power as an author has been shown in many ways, notably by his publication of organic syntheses and by the first edition of the book under review. The revised edition is published after six years with the assistance of Dr. Max Tishler, research chemist at Mercks. The new matter deals mainly with the advances made in that region which lies between abstract organic chemistry and biology, because it is undoubtedly along the lines of organo-physiology and organo-pathology that discoveries of vital importance to mankind will be made.

It is doubtful whether we shall succeed in discovering the true chemistry of life, but we shall get sufficiently near to that discovery to enable us to prepare biological substances the lack of which in the human system leads to disease and death. It is perhaps impossible to renew the worn-out human machinery but by the application of essential organic compounds, which the ageing system fails to produce, it will be possible to prolong life far beyond the three score years and ten of the Psalmist. Whether this is desirable or not is an open question, for youth is not likely to view with equanimity the picture of seniors active and virile at the age, say, of one hundred and twenty. Values must, however, adjust themselves in this ever-changing world, and if men can retain all their faculties at one hundred and twenty years of age, they are not likely to consider the objections of youth in the matter.

In Conant's book, although it bears the subtitle—"A Year's Course in Organic Chemistry" and is therefore written for those other than the men who intend to make organic chemistry a life-study, much of the higher biology is given in full detail. It is clear that the authors understand the great truth which all those who appreciate the science must recognize, namely, that it is only by the combination of organic chemistry and biology that progress can be made. Ultimately, the empiricism of biology will disappear and the new science of biochemistry will be based on organic structure and principles. When this happens, the clouds will pass away and in the brilliant light of the unfettered sun, discoveries will be made of far-reaching importance to the human race.

(3) This practical organic chemistry is doubtless a useful book for laboratories in which the course of laboratory work followed is in accordance with the text. For it happens that text-books of

this kind are usually written for the course chiefly to assist the teacher; it is rarely that the course is dependent on the text-book, although in some instances this may be the case. The present book is probably written of the Cambridge laboratory course and shows incidentally that teaching in these laboratories is based on right principles. The book, no doubt, will serve for any of the organic courses in our universities and university colleges, but there it will have to compete with a host of similar books, some written for the requirements of a course, which are practically unassailable, having become firmly established by usage, others of general application which again have been established by long usage and are also practically unassailable from outside.

Nevertheless, the book under review is a good one and deserves fully all the success it can obtain. It is difficult to say, however, that it has any outstanding features which render it a book apart from its many competitors.

JOCELYN THORPE.

ENZYMES

Die Fermente und ihre Wirkungen
Von Prof. Dr. Carl Oppenheimer. Supplement. Band 1 (zu Band 1, Specieller Teil: Haupt-Teil 7–12.) Pp. xii+782. Band 2 (zu Band 2, Specieller Teil: Haupt-Teil 13–22). Pp. x+783–1738. (Den Haag: Dr. W. Junk, 1936, 1939. 2 vols., £12 10s. Bibliography (1924–1938). Pp. 1–128.

FORTY years ago probably relatively few chemists or physiologists had any knowledge of enzymes, which were considered to be somewhat mystic bodies; the biochemist, if he existed, was regarded as a hybrid. Emil Fischer had put aside the sugars for the time and commenced his work of taking the proteins to pieces.

To-day it requires a book of 1,738 pages in order to give concise information about the enzymes, and this is a supplement to an equally large volume, and consists mainly of new matter and not a repetition of the old. The preface to the supplement is dated August 1936 so that it has been three years in preparation, obviously three years of hard labour for the compiler.

The constitution of the enzymes is largely unknown; they cannot be listed and formulated in the graphic chemical shorthand which has so facilitated the progress of chemistry and enables the expert to achieve so much with the vast majority of natural and synthetic substances. This makes it doubly difficult to deal with the enzymes in books: they have to be classified by what they do, by the reactions for which they act as catalysts, rather than by what they are.

The difficulty has been largely overcome by Oppenheimer by an elaborate division into classes and frequent subdivision into entities resembling a zoological catalogue, and ultimately into numbered paragraphs. In consequence, with the aid of the schedule of contents it is as easy to look up a particular enzyme as it is to look up a compound of known structure in an organic chemical dictionary.

The task has been accomplished and the book contains the latest up-to-date information about each and every enzyme, in the space of a few pages in paragraphs, subject only to the time lag of publication. It has been issued in parts, at irregular intervals during the three years, of which ample reviews have been given in these columns with the object of keeping workers on particular enzymes in touch with the progress of the supplement.

The extent of the interest in enzymes is evidenced by the amount of published work on them. The research has gone on side by side with that on vitamins and hormones, and some connexion or relation between these and the enzymes is beginning to appear. Their significance as catalysts of vital reactions has long been realized, but the stage has now been reached of understanding the mechanism of such reactions and the manner in which enzymes take part in them. Vitamins and hormones have become therapeutic agents, they are injected or taken by the mouth so that a deficiency in the body of such 'reaction-promoting' materials can be corrected. This is scarcely true as yet of the enzymes though they are sometimes administered; more probably, the giving of hormones liberates enzymes which were previously dormant and brings them into action.

Apparently; vital reactions take place in a chain though, as this term has been appropriated by the physical chemists to connote another type of reaction, it is necessary to substitute the term 'series of substances'. Each compound in the series does something to or with another; the presence of each is necessary for the completed reaction. Some of the compounds are ordinary normal products of the cell, some are present only in minimal quantity, others are in the resting state as part of larger complexes and have to be unlocked, so to speak, before they react. A satisfactory book of reference contains the facts or indications of such, from which the worker can build up further experiments and check his own theories.

From time to time there arise individuals, diligent and of orderly mind, gifted at cataloguing and summarizing the literature. Beilstein has done this for organic, Mellor for inorganic, Abderhalden for physiological chemistry, Oppenheimer for enzymology. The completion of this work entitles him to be ranked with these others as a benefactor to experimental science.

All of them have made it easier for workers to-day to press forward their experimental investigations by which alone, slowly but surely, the truth is unveiled.

E. F. ARMSTRONG.

BIOLOGY FOR SCHOOLS

(1) A School Course of Biology

With Suggestions for Practical and Field Work. By L. J. F. Brimble. Pp. x+470. (London: Macmillan and Co., Ltd., 1939.) 6*s*.

(2) Biology for Junior Forms

With Instructions for Simple Practical Experiments. By M. R. Lambert. Pp. 320. (London: Macmillan and Co., Ltd., 1939.) 3*s*.

(1) IN the preface to his book, Mr. Brimble writes that "the teaching of biology is still in the experimental stage, and thus the completely satisfying course which covers the period allocated to it in secondary schools is still to be formulated". It is inherent in the nature of progress that this completely satisfying course may never be attained, but it stands to the author's credit that here, as in his "Intermediate Botany", he has made a valuable contribution to biology teaching. "A School Course of Biology" bravely attempts to deal with biology as a whole science in which no use is made of the "convenient" divisions into botany, zoology and physiology. The other general feature of importance is that the elements of human biology are liberally distributed throughout the text, and here lies the reason for much of the intrinsic value and attractiveness of the book.

Although the requirements of candidates for school certificate and matriculation examinations are more than adequately provided for, whenever possible the author has carefully diverted the issue to deal with matters that make up the natural and ever-present interests of pupils. Great prominence is given to economic uses of plants and animals, and attention is focused upon the human being in a section on human anatomy and physiology, with the attendant medicine, hygiene, health and fitness. Historical references are repeatedly inserted to illumine the facts presented. The pupil is invited to consider familiar plants and animals before attempting the unfamiliar. Another feature of considerable value is represented by the author's attempt to inculcate the spirit of inquiry by the frequent inclusion of suggestions to the effect that though much is known in science, the vast ocean of discovery lies largely uncharted.

Each chapter contains suggestions for practical work and, as an aid to examination candidates, some two hundred typical questions are provided. The 355 diagrams and photographs have been collected from many sources and are varied in appearance. The great majority of the diagrams have been prepared by the author himself; these are uniformly excellent. It is to be desired that, when the book reaches its second edition, the author should even further extend its attractiveness by replacing the few poorer diagrams by yet more of his own. There are a few inaccuracies which are of a trifling nature. The only outstanding omission is that no reference is made to the pasteurization of milk, and the section dealing with soil might have been extended.

Mr. Brimble's book should soon find its way to all schools where biology is taught and should be a real boon at present to teachers whose schools have been evacuated.

(2) "Biology for Junior Forms" is the adapted third book of a series that was written for senior schools. This series was written using a concentric system so that each of them would cover a year's course. The third book has accordingly been published for use in the junior forms of Secondary Schools. It is doubtful, however, if it will achieve the same success in its present form as in the original. The pace of the introductory chapters appears to be too rapid for younger pupils, strange terms frequently being introduced without adequate explanation. The references to the earlier books of the series might also be disturbing to pupils having no previous acquaintance with them, while the exclusive divisions into botany, zoology and human physiology could scarcely be permitted in a book that is meant to be the foundation for Mr. Brimble's book on biology.

This little volume contains much useful material, however, and with a different presentation would perform valuable service in the lower forms of secondary schools.

T. H. HAWKINS.

CIRCULATION OF THE BLOOD

The Control of the Circulation of the Blood
By Prof. R. J. S. McDowall, with the assistance of Lt.-Col. G. E. Malcomson and I. McWhan. Pp. xv+619. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 73*s*. 6*d*. net.

PROF. McDOWALL is to be congratulated on the production of a comprehensive 'Handbook' on the control of the circulation of the blood, with seven thousand references to other works. It is surprising that he has found time to write it without interrupting either his teaching or his research work. His book covers the ground as completely as such books can, and does not follow the easy course of disposing of early work by reference to previous reviews, but contains much discussion of work published before 1900, where such work is still considered important.

A few minor errors are inevitable, and a warning to this effect is contained in the preface. They can do little harm, since no serious man of science would rely on a monograph without referring to the original literature. The 38 figures are all taken from the author's own experiments, and their even distribution through the book reflects his close practical knowledge of all the problems discussed.

There are 150 pages dealing with the control of the blood vessels in various parts of the body, 100 pages on the heart, 80 pages on adrenaline, and chapters on the effects of carbon dioxide, anoxæmia, temperature, sleep, exercise, posture, hæmorrhage, the pituitary, the hypothalamus, and vasodilator substances. The action of ions and the chemical transmission of nervous impulses are deliberately and wisely omitted; but it is a pity that there is no adequate account of the various theories that have been propounded to account for vascular shock. Perhaps the explanation is that the book has been confined to physiological phenomena, and shock is excluded as pathological.

All physiologists who work on the circulation will covet this book, which will give them a long list of references, and a considered summary of many problems. It will save some of them from arduous searches in libraries and others from the publication of facts already known.

J. H. GADDUM.

STUDIES IN TELEPATHY

Experiments in Telepathy
By René Warcollier. Edited and abridged by Gardner Murphy from "La Télépathie", articles in the *Revue Métapsychique*, and recent Unpublished Studies. Translated by Josephine B. Gridley. Pp. viii + 250. (London: George Allen and Unwin, Ltd., 1939.) 7*s*. 6*d*. net.

THIS book is a collection of material taken from various publications by M. René Warcollier and put together with a foreword by Prof. Gardner Murphy of the Department of Psychology of Columbia University.

For some thirty years, M. Warcollier has been studying the phenomena ascribed to telepathy, and in this volume he sums up his impressions of what he has learnt and gives numerous examples of successes in the reproduction of drawings, diagrams, etc., many of which are clearly not due to chance alone.

The main object of this collection of papers is not so much to offer fresh evidence for the existence of a telepathic faculty as to study and discuss the mental processes involved, and to try to ascertain how to produce the phenomena at will and thereby to initiate a detailed examination of the laws underlying them. Although the author was not successful in discovering any basic laws, his notes provide suggestive material for future experimenters. Thus some of his results indicate that ideas repressed by the agent seem to be transmitted better than those upon which his attention has been concentrated; whilst the factor of the agent's own activity as compared with that of the percipient is seen in a number of experiments. On the other hand an increase in the number of agents seems to lessen their influence, whereas the opposite is true as regards the percipients, who, in certain cases, appear to be in mental rapport with one another.

Although much of M. Warcollier's work does not seem to be open to the kind of statistical treatment which is now being applied to problems of this kind, and through which we may hope to gain a greater insight into the questions involved, his work is of considerable interest, since he is particularly concerned with the kind of mental factors at work if the phenomenon is a real effect and not due to unascertained normal causes.

THE PUBLIC RELATIONS OF SCIENCE*

BY DR. WESLEY C. MITCHELL,
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UNTIL recently the attitude of the public toward science seemed to be growing more appreciative. There have always been folk who objected strenuously to the supposed implications of certain scientific hypotheses, but on the whole science was generally esteemed the most progressive factor in culture, man's best hope for bettering his lot upon earth. Of late this tide of approval has ebbed. There is a widespread disposition to hold science responsible for the ills men are bringing upon themselves—for technological employment, for the rise of autocracies, for the suppression of freedom, for the heightened horrors of war. For their part, scientific men are appalled at the hideous uses to which their discoveries are put. They feel an urge to combat the misuses of science, to protect the social values they cherish, but what they can do is not clear. The quandary is one that all who cherish science should face, however unwelcome and difficult the task.

I

Let me start by recalling certain changes in the relations of science to society that may help us see our present problems in historical perspective.

The beginnings of scientific knowledge have been traced to man's dealings with the implements of his daily life—the sticks and stones, the skins, fibres, and clay he shaped to his uses, and in the shaping learned to know. At a later stage of cultural advance, thinking about natural phenomena, like thinking about religious observances, tended to break away from direct associations with daily work. Such efforts to understand the world as the Middle Ages made were concerned chiefly with problems of a divine dispensation. Observation was not pertinent, and factual tests of conclusions were not possible.

The re-birth of science in the sixteenth and seventeenth centuries was accomplished by turning from the study of concepts back to the study of Nature. The new orientation was characterized by close observation, by the invention of devices to make observation more penetrating and accurate, by purposeful experimentation to simplify the processes observed, by close attention to quantity as well as to quality, by the practical application of mathematics to express the relations observed, by reformulation of concepts to fit the findings, by critical checking of one investigator's work by others, by the cumulation of tested conclusions in old fields of research, and by the extension of this mode of inquiry to new fields. Inventing instruments for observing, setting up experiments, measuring, and testing brought science again into intimate touch with the practical arts. Investigators took a keen interest in current affairs, sought to profit by the skill of craftsmen, and to put what they learned to practical uses. Discoveries were applied not only to the production of goods, but also to navigation, fortification, ballistics, and administration. By the close of the seventeenth century the dramatic achievements of 'natural philosophy' were leading many to expect an almost limitless advance, and the promotion of science was recognized as a proper object of public policy. Kings lent their patronage to scientific societies. Philanthropists followed the royal precedents by offering prizes for improvements in the arts and later by endowing research.

Of course the public relations of science were not uniformly harmonious in this age of genius. But the celebrated clashes between scientific discoveries and beliefs held by churchmen did not affect many lines of inquiry and did not gravely retard the rising tide of investigation. Not less characteristic of the age than Galileo's troubles were Newton's services to churchly teachings and to the State. Scientific men have lamented that he devoted his later years to arguing the validity of biblical prophecies; they have paid less attention to his work as Warden of the Mint. It was adjustments in the weights of the guinea and the shilling suggested by Newton that gave England a *de facto* gold standard in the eighteenth century.

An even more striking example of close relations between research and service to mankind is the life of Benjamin Franklin. The foremost American discoverer of his time, he was foremost also in applying and disseminating science to make life more comfortable, more secure, more interesting, more humane. These activities were incidents in the life of a busy printer, editor, politician, postmaster, legislator, colonial agent, and diplomat. But while we wonder at the extraordinary versatility of a man who could become both a scientific discoverer and a great statesman under any conditions, we must remember that in Franklin's day science was still in its 'natural philosophy' stage.

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* From the address of the retiring president of the American Association for the Advancement of Science, delivered on December 27 at Columbus, Ohio.

With the cumulation of results, science became a more exacting mistress, requiring of her votaries more exclusive attention. But science did not draw away from the material tasks of daily life as it had in Greece. On the contrary, these relations were becoming more intimate, while scientists were learning to speak symbolic dialects less and less intelligible to the public or even to one another. Let me illustrate the seeming paradox by the relations between science and industry.

To most of us the modern age is characterized by technological progress as markedly as by scientific discovery. We think of the two achievements as interdependent. This interdependence was less obvious to Franklin's contemporaries than to us. Theirs was a century of great inventions, but inventions made mostly by men not trained in science. The captains of industry who carried the Industrial Revolution through its youthful phases were often technical experts, business executives, and capitalists united in one person. Men of this versatile type are still to be found even in 'big business'; but they are becoming as rare as once they were common. For, as technology was elaborated, experts with special training were required to supervise its operations.

The economic results produced by this unplanned organization of mutually stimulating activities astonished mankind. Industry after industry reorganized its processes time and again to take advantage of the latest engineering applications of scientific discoveries, and new industries kept cropping up. The efficiency of human labour increased greatly, *per capita* income rose, and hours of labour declined. Higher standards of living, and applications of science to the prevention and cure of disease, reduced death-rates and prolonged the average duration of life. Population grew rapidly in the nations that led the scientific procession, and spread where it would over the earth, dominating, exploiting, sometimes exterminating the non-scientific peoples. Life became ampler if not easier for the beneficiaries of science.

What industry owed science it repaid in many ways. It provided in bewildering variety laboratory equipment more accurate and powerful than that made by hand. It stood ready to construct any new contrivance an investigator designed, and often improved upon the original plans. Fortunes accumulated in business were the source of many scientific endowments. Business corporations granted research funds to universities, and set up research staffs of their own, which were sometimes permitted to work upon fundamental problems.

Governments recognized the social importance of science by making place for an expanding array of scientific courses in public schools and universities, and by undertaking wide-ranging programmes of research. In the United States, the Federal Government became the largest employer of scientific men. At the time of the Civil War it chartered the Academy of Sciences, and in the War of 1914–18, the National Research Council to advise it upon scientific problems; in 1934, it set up the organization that has developed into the National Resources Planning Board, with affiliations covering the full gamut of the sciences.

Finally, the public at large had a share in these great changes. It was the ultimate beneficiary of reductions in costs of production, of increasing *per capita* output, of new types of consumers' goods, of shorter working hours, of better protection against disease, of free education.

In short, this policy of *laisser-faire* worked wonders. Science helped industry and industry helped science. Even the backward art of agriculture, which faces so many difficulties and uncertainties, was benefiting by research. The dreaded 'law of diminishing returns' seemed to be overbalanced by improvements in practice based upon the work of soil chemists, botanists and geneticists. The frightful prospect of overpopulation that Malthus had taught the thoughtful to fear seemed to be dissipated by scientific agriculture and scientific techniques of contraception. Best of all, science seemed to have found the secret of illimitable progress.

II

I doubt that any scientist ever accepted without qualification this idyllic version of the benefits science confers upon mankind. Certainly there were numerous protests from scientific quarters against misuses of the new technology. Geologists and economists warned against the rapid depletion of mineral deposits. Chemists feared for the nitrogen content of the soil. Geographers and meteorologists protested that wholesale cutting of forests and the ploughing of grass lands produced deserts. Biologists lamented the extinction of animal species and anthropologists the callous stamping out of simpler cultures. Social scientists found much amiss within the countries that were most progressive. Urban and rural slums persisted as centres of disease and crime. The need of securing capital to utilize the new technology put control over it into the hands of the propertied classes. Labour was often grievously exploited. Huge fixed investments that could be used for only one purpose made competition destructive. The obvious escape from these hazards was to form monopolistic combinations. That was pleasant for the monopolists, but not for other business men or for consumers. Besides the obvious dangers of exploitation, many feared that the great combinations might purposely slow down technological advance because it threatened rapid obsolescence of their equipment.

Business did not manage even its own interests properly, for every few years it generated a crisis and depression in which it suffered along with the whole community ; and the international relations of the scientifically advanced peoples showed at his worst "the old savage in the new civilization". Demonstrations of the economic advantages of free trade no more stopped the imposition of protective tariffs than demonstrations of the horrors of war kept peace. Militant nationalism seemed to be spreading and growing more passionate. An appreciable fraction of scientific energy was devoted to contriving weapons of destruction. Thus against the glowing pictures of science as a benefactor of mankind could be set a dark picture of science putting more power into the hands of certain individuals, classes, nations, generations, giving them a differential advantage over others which they exploited according to their several natures.

Though some of the Jeremiads I have been recalling belong to an earlier time, they did not produce a profound effect upon the public relations of science until recently. The ills complained of could be regarded as 'growing pains'. They represented social 'problems', which should be dealt with by arousing public opinion in a campaign of education that would lead to remedial legislation. Problems that could not be solved by this time-honoured method would yield presumably to the slower processes of general enlightenment.

This optimistic attitude was particularly characteristic of democratic nations. It assumed tacitly that experts could devise whatever 'reforms' were needed, and that the majority of voters were intelligent enough to understand, and well disposed enough to support, desirable changes. Science had a stellar role in this programme for remedying the ills incidental to progress. It did not claim knowledge of good and evil ; but it enabled men to make their value-judgments more intelligent by tracing the consequences of actions. Many people were devoting their energies to the study of social problems ; they spoke optimistically of their subjects as social 'sciences'. It seemed not too much to hope that science might presently begin to guide social practice in somewhat the same fashion as it guided practice in industry and medicine.

III

That the public relations of science have recently become disturbing both to the public and to scientists is due, not to any change in the character of science or the behaviour of scientists, but to changes in social conditions. While most people approved on the whole of the applications of science before 1914, they have come to dislike many of the effects produced by later applications. To be specific : when scientific improvements in one industry after another threw men out of work in earlier decades, the victims might suffer in silence or protest riotously and perhaps smash machines. But the public at large was not deeply concerned over their sufferings ; it repressed disorder, expected the displaced men to find new jobs for themselves, and blessed science for reducing costs of production. Now that a larger part of the public suffers from loss of work or obsolescence of investments, science is blamed for technological unemployment. When the modern arts of communication were used to facilitate the political processes of democratic nations, they were extolled on all sides. Now that these arts, further improved, are controlled in some countries by autocratic Governments and used to suppress opposition, many good people treat science as the culprit. When the scientific nations used their superior arms against backward peoples, only a few sensitive souls were wrathful over the unfairness or iniquity of the procedure. Most people felt that science was good when it gave them a decisive advantage over those they wished to 'civilize'. Now that these same nations are threatened by still more terrible weapons in the hands of their peers, their moral horror is sincere, and they wish scientific warfare back to the pit from which it was digged.

This shift in attitude toward science as one happens to benefit or suffer from its applications is doubtless a mark of human frailty, but it is one at which scientists should not cavil without recalling a similar frailty of their own. Now that we are on the defensive, we discover that science is neither good nor bad in itself, but is merely an instrument that can be put to good or bad uses, and that the blame for bad uses should be visited upon those responsible for them. But when science was being lauded for good works, who among us argued that the credit belonged, not to science, but to those who used it for the benefit of mankind ?

We made this discovery when difficulties forced us to think more carefully about the place of science in society. Well as the old policy of *laissez-faire* in public relations worked for a time, it had encouraged in us an indolent complacency foreign to the critical spirit of inquiry. We may not enjoy the shocks that have aroused us any more than an investigator rejoices over facts that disprove an elegant hypothesis ; but we must face the situation and see what we can do to mend it. I venture to suggest an obvious proposition that seems to me of controlling importance, and to point out certain corollaries that should guide both our attempts to understand the public relations of science and our future policy concerning them.

IV

The fundamental proposition is that scientific research is a social process as much as business, political, or religious activities are, and as such is interwoven with all other social processes, influencing them and being influenced by them. It is one among many social activities carried on by the peoples of our culture. Like all such processes, it is carried on by men who learn in childhood languages ill-suited to close thinking; by men who wish to eat, to make love, to win approval as well as to know; by men who are reared in an environment of emotional likes and dislikes; by men who become so absorbed in their technical tasks that they have little energy to criticize the non-scientific parts of their own make-up. These scientific men form a tiny fraction of their communities. So far as they succeed in emancipating themselves from the misconceptions and prejudices prevailing in their social groups, they become by virtue of their partial emancipation queer creatures whose judgment most people mistrust outside of their specialties. Both the temperament that inclined them to research and the habits they form in research tend to make them awkward, ineffective, reluctant in appealing to the emotions that are so potent in influencing men.

It is difficult to see how a few scattered individuals, each accustomed to think for himself and to be critical even of his fellow inquirers, can guide public opinion except by slow educational processes. In the long run, their thinking may rule the world, just because it serves the purposes of mankind better than the traditional thinking it gradually replaces. But in the short run, others take of scientific discoveries only the parts that have an immediate application, and put these parts to such uses as they see fit—uses that serve whatever aims these others pursue. The prompt and potent influence of science upon society comes from these uses, good and bad, which scientists control only in small part.

Even in democratic countries, then, scientific men find it hard to bridge the gulf between their attitudes and those of the general public. In autocratic States the Governments might give scientists fuller opportunities to direct public policies than they enjoy in the democracies. But the autocratic States known to us are not built on that model. They are avid for science, to be sure, but only for science that is an uncritical servitor of ends the rulers determine. As between the difficult public relations confronting them in democracies and the shackling of free inquiry confronting them in autocracies, scientists cannot hesitate. Theirs is a world of intellectual freedom, not perfect alas, but the freest world the mind of man has yet created, and to let any authority under any pretence prescribe what conclusions they shall accept as scientific is to stultify the spirit of science.

V

What, then, can scientists do to improve their public relations in communities where they are relatively free ?

As I see the situation, they have two sets of opportunities and responsibilities; first, their opportunities and responsibilities as citizens; second, their opportunities and responsibilities as investigators.

What scientific men can do as citizens is like what other intelligent men can do. If democracy is to work well, many people must form considered judgments upon a wide variety of problems. In forming a considered judgment on a given issue, what experts have to say should be taken into account. Who these experts are depends upon the character of the issue; more often than not contributions are needed from several kinds of specialists. All the many species of the genus scientist belong at one time or another in the list of desirable technical advisers; so also do lawyers, business organizers, labour leaders, social workers, educators, civil servants, politicians, and so on. When matters within the competence of some group of scientists are involved, they should contribute what they know, whether formally invited to do so or not. To make their advice effective they should welcome help from people more skilled than themselves in the arts of popular presentation. On matters concerning which a scientist has no special knowledge, he should listen to others and form the best judgment he can from what they advise. To an individual this task of sifting and weighing different opinions is time-consuming and difficult. On complicated issues organization is needed to bring into focus all the intelligence available in the community. Hence one of the civic duties incumbent upon all scientific men in common with other citizens is to support vigorously but critically the nascent movement toward organizing all the intelligence we possess for constructive study of social problems, before they become pressing emergencies that have to be dealt with in a hurry that allows no time for careful thinking.

The outside limits of what scientists can accomplish as citizens are set by their ignorance. Not merely does no individual have more than a tiny fraction of the knowledge that is needed; all the scientists of the country put together do not know enough to solve many of the problems that a democracy faces. In addition to the responsibilities they share with all other citizens, scientific men have the special duty of trying to increase the kind of knowledge required to deal intelligently with public problems. Their opportunities and responsibilities as citizens merge into their opportunities and responsibilities as investigators.

From the social point of view, the most urgent item in the unfinished business of science is to increase knowledge of human behaviour. If we had keener insight into individual psychology, we might not be able to alter fundamental drives, but we might be able to direct them into beneficent channels. Preaching righteousness doubtless prevents men from being as bestial as they might otherwise become. Appeals to reason prevent them from making as many errors as they otherwise might. But the moralist and the rationalist admit that the results of their efforts are grievously disappointing. Scientific men with any gift of self-analysis realize that they have their own shares of selfishness and animosities. To subdue traits in oneself is hard enough to give an inkling of the difficulty of controlling them in society at large. Perhaps—and perhaps is all we can say—if we can come to a clearer understanding of how we behave, we can learn how to condition men so that their energies will go less into making one another miserable.

We all know that the social sciences lag far behind the natural sciences. That is because they deal with phenomena more complicated, more variable, and less susceptible of experimental manipulation. Since social investigators cannot experiment at will upon social groups, they cannot effectively apply to their problems the methods that have made the laboratory sciences strong.

Yet the case of economics and its sister sciences is not hopeless. The rapid growth of statistics is providing mass observations upon social behaviour of many kinds; the equally rapid growth of statistical technique enables us to learn more from a given array of data than our predecessors could. These materials and methods are making it possible to measure many social factors, some rather accurately, some roughly. Uniformities appear not only in averages, but also in the way in which individual items are distributed about their means. Statements in terms of probability can be substituted for vague statements about the effect a certain cause 'tends' to produce. True, work on this observational basis encounters many difficulties. It is limited by the variety, extent and accuracy of reliable data upon human behaviour. It is laborious, slow and expensive. In presenting his work a realistic investigator begins with a critique of his data and methods; he ends by setting forth the probable errors and limitations of his results. and the road from the beginning to the end may be long. Instead of definitive conclusions he thinks others should accept, he presents tentative approximations he expects others to improve. The work has not even the advantage of calling for less hard thinking than speculative theorizing; for the relations among the variables in the problem are seldom manifest of themselves. All that can be claimed for this type of work is that it deals with actual experience, that its results stand or fall by the test of conformity to fact, and that it grows cumulatively after the fashion of the observational sciences. But that is enough to give mankind strong reason for following this lead in seeking the knowledge required to improve social organization.

But science cannot flourish in the future and yield the fruits for which we hope unless freedom of thought prevails. The democratic way of life and the scientific way of thinking grew up together, each nourishing the other. If one now fails, the other will falter. Where democracy is suppressed to-day science is fettered; for autocracy cannot brook disinterested criticism of its dogmas or its practices. Freedom of scientific work in the years to come can be guaranteed only by preserving the institutions that secure freedom to all citizens.

Perhaps scientific men have more at stake than any other social group in the struggle to maintain democracy. To this struggle they can make a crucial contribution. The fact of free societies hangs upon the wisdom or folly of mass decisions. The gravest dangers to democracy come from within, not from without. They are ignorance, and propaganda that turns ignorance to its uses. The best way of dispelling ignorance is by diffusing knowledge. The most effective defence against meretricious propaganda is critical inquiry. John Dewey is warranted in saying that "the future of democracy is allied with spread of the scientific attitude". To foster this attitude among their fellow citizens by all means within their power is a duty incumbent upon us who cherish science. As teachers in schools and colleges we can help thousands to develop respect for evidence. As citizens we can be brave opponents of prejudice and hysteria. We can promote general understanding of the methods and results of science through our own writings or those of allies more skilled in popular exposition. These things we should do, not as high priests assured that they are always right, but as workers who have learned a method of treating problems that wins cumulative successes, and who would like to share that method with others.

A NEW APPLICATION OF ECHO-SOUNDING

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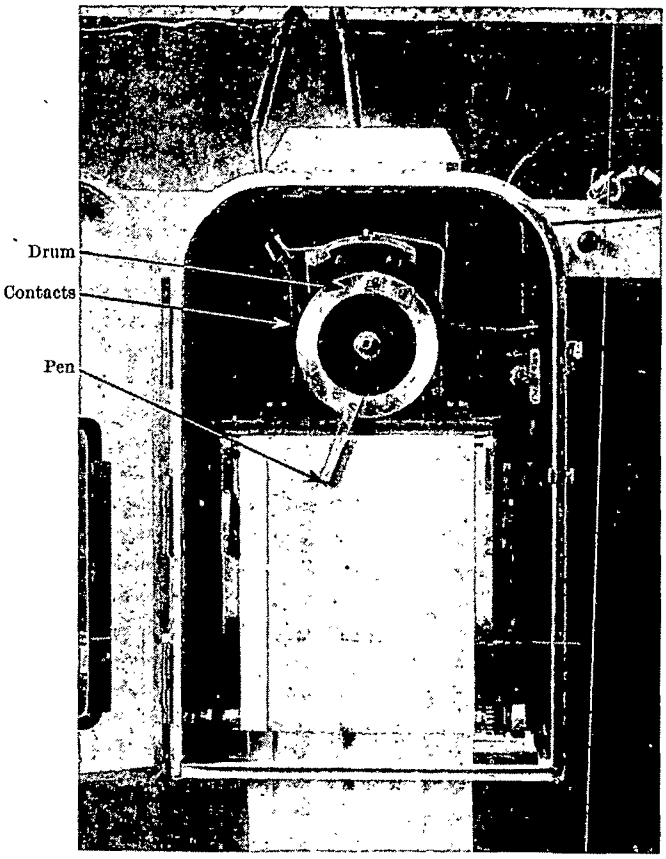

Fig. 1.
THE HENRY HUGHES ADMIRALTY PATTERN ECHO-SOUNDING RECORDER.

BY 1937 the biological researches at Wray Castle had reached the stage when a detailed bathymetric survey of Windermere was desirable as a basis for studying features of the lake bed. The Hydrographer to the Admiralty kindly agreed to co-operate on the technical side, and a survey was carried out by Lieut.-Commander Farquharson, of the Admiralty's hydrographic staff, using a magneto-striction recording echo-sounding machine of Admiralty pattern manufactured by Messrs. Henry Hughes and Son, Ltd. The main feature of the recorder (Fig. 1) is a drum which is rotated at a constant speed by an electric motor. An arm attached to the drum carries a metal 'pen' which traces the record on paper moistened with solution of potassium iodide and propelled slowly through the machine. Contacts on the drum are arranged in such a manner that a supersonic sound impulse is transmitted from an oscillator, below the surface of the water, for an instant when the revolving pen has just begun its transit across the paper. The sound impulse, directed downward, is reflected from the bottom, is picked up by a receiving oscillator also mounted in the water, is amplified and passed to the pen. The rises in voltage at the pen point, consequent on the transmission and return of the signal, cause electrolysis of the potassium iodide and produce brown stains of iodine on the paper—one, the zero mark, at the instant of transmission, and the second on the reception of the echo. The distance along the arc of the pen's track between these two marks represents the depth of water, and the process, repeated at each revolution of the drum, gives a continuous record of depth. The whole equipment, consisting of the recorder, amplifier, oscillators and 12-volt accumulator, can be mounted comfortably in a small launch or rowing boat.

In the survey of Windermere 260 cross-sections, representing some 150 miles of continuous sounding, were recorded during five weeks, and the measurements of depth were afterwards made available by the Admiralty on the 6 in. to a mile scale, with certain areas in greater detail on 25 in. to a mile maps. The results of this survey, sufficiently valuable in the information they provided regarding the depth of water, proved to be of much interest in quite another way. Many of the records not only showed an echo from the floor of the lake, but also a second, though fainter, echo, and sometimes more, at vertical distances (measured on the records) of up to 13 metres below the lake floor. It is known that much of the lake bottom is covered by soft mud of considerable depth, presumably overlying rock or glacial clays which formed the floor of the lake at the conclusion of the Ice Age. Therefore, it seemed that the double echo shown on the records could be explained on the assumption that only some of the sound waves transmitted by the machine were reflected from the interface between mud and water, and that others penetrated the waterlogged deposits and were reflected by the harder glacial clay or solid rock underneath. In other parts of the lake (*A* in Fig. 2) the bottom appeared as an intense black mark with one or more fainter marks below, at apparent distances below the bottom equal to the depth of water. In such cases it seemed justifiable to assume that all the sound waves were reflected from a hard bottom and that, since an air-water interface reflects supersonic sound, they were afterwards re-echoed to and fro between the surface and bottom. If these interpretations were correct, the echo-sounding machine could be used to give information regarding the kind of bottom and the depth of soft deposits. Accordingly, the research was followed up by (1) making observations on the deposits themselves, and (2) carrying out surveys with the echo-sounder on fourteen other of the larger lakes in the district.

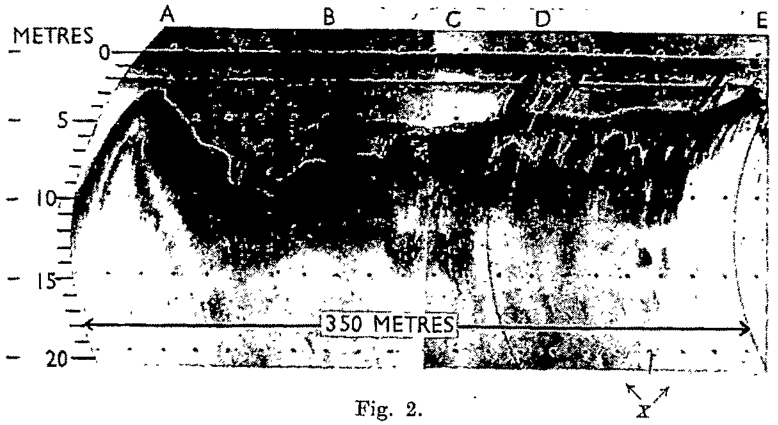

Fig. 2.
Echo-record of a section across Low Wray Bay, Windermere.
X are time marks recorded every thirty seconds.

In the first of these projects, sections such as that shown in Fig. 2 were examined and it was confirmed by the use of lead and grab that at *A* the bottom is bare rock, at *B* it is soft mud, at *C* stiff clay overlain by a thin deposit of soft mud. At *D* beds of water weed (Potamogeton) growing in the mud were under the oscillators as the superficial marks made their appearance on the record, and at *E* a stony bottom could be seen through the shallow water. Direct measurements of the actual depth of soft deposit were made with a probe of special design constructed by Dr. J. A. Ramsey of Cambridge. Of twenty-one such measurements made under favourable conditions, all showed depths which agreed to within a foot with the depth of deposit as indicated on the echo records. In addition, cores of the deposits have been obtained from some parts of the lake, first with a simple tube driven into the bottom and later with a special core-sampler described previously[1]. The examination of cores is important because many of the echo-records (for example, at some points in Fig. 2) indicate stratification of the deposits. Moreover, the cores throw light on the post-glacial history of the lake basin: they show fine varving in the deposits, and there is an alternation between periods in which inorganic, probably ice-eroded, particles are predominant with periods when the bulk of the deposit is made of the shells of diatoms. The succession of diatom and other organic remains in these cores is being studied by Miss W. Pennington of the University of Reading.

The surveys of other lakes, made by members of the staff at Wray Castle, serve to confirm the main bathymetric features as determined by H. R. Mill[2].

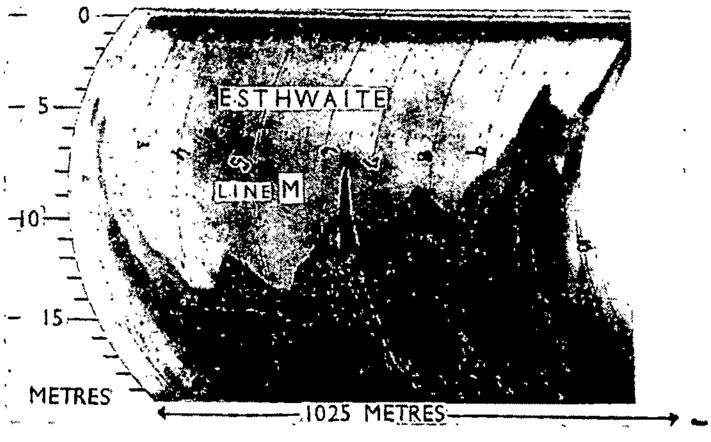

Fig. 3.
Echo-record of section across Esthwaite Water.

These surveys were not of the same detail as that of Windermere, but sufficient sections were recorded to obtain a good idea of the bottom characters. The photograph of a representative record from Esthwaite Water, reproduced in Fig. 3, shows a mound of hard bottom projecting through an even layer of soft deposit. Over the rest of the section the thickness of soft deposit is roughly uniform and the mud profile follows in smoother outline the irregularities of the hard floor below. In other cases, for example at *D* in Fig. 2, such irregularities are masked by a level blanket of mud. Fig. 4 shows another type of sedimentation in a region—the narrows joining the north and south basins of Windermere—in which an appreciable water flow is to be expected. The figure shows a scoured channel on one side with a mud bank on the other, a condition which might be expected from the configuration of the locality. A more complex kind of sedimentation, in which the deposit appears to be divided into a series of strata, is suggested by other records. All these types of record have been exactly reproduced over the same positions at different times by two recorders having differences in the details of construction, and recording on different scales.

It must be emphasized that further direct observations on the deposits are required before the interpretation of the echo-records can be accepted without reserve. The speed of travel and the penetration of supersonic sound in water-logged deposits have yet to be determined, and the nature of the interfaces from which it is reflected awaits investigation. But it seems probable from the results mentioned above that the echo-sounding machine provides a means of measuring the result of subaqueous deposition over long periods of time. Such measurements would be of practical use in connexion with reservoirs and harbours where the deposition of soft deposit on a hard floor often takes place rapidly. They would also be of much interest to hydrographers, geologists and limnologists. For example, in each lake so far examined, the total volume of soft deposit, as computed from the echo-records, is found to be related to the size and character of the drainage basin. This is illustrated in the accompanying table of values for selected lakes.

	Mean depth of water (metres)	Mean depth of deposit (metres)	Volume of deposit (10^6 cubic metres)	Drainage area (sq. km.)	Volume of deposit / Drainage area	% drainage area on uncultivated hills
Haweswater	12·0	0·52	0·7	29·1	2·4	92
Ennerdale Water	18·9	0·88	2·5	44·1	5·7	94
Coniston Water	24·1	1·09	5·4	60·7	8·9	78
Windermere	23·8	1·62	24·1	230·5	10·5	70

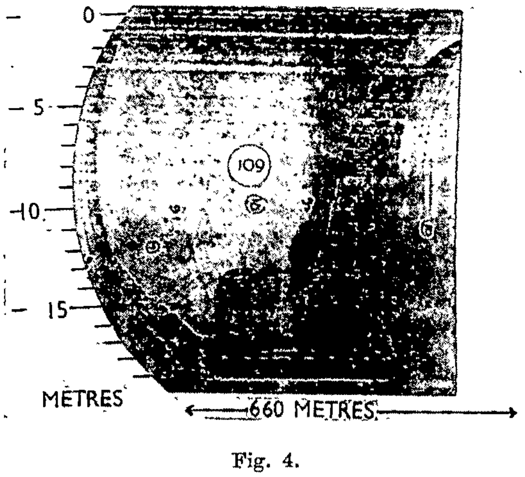

Fig. 4.

ECHO-RECORD OF SECTION NEAR THE FERRY, WINDERMERE.

The figures in the last column but one represent the depth of deposit in centimetres if it were spread evenly over the whole drainage basin, and may be regarded as an index of silting rate. Pearsall[3] showed the controlling influences of the silting rate on the distribution of aquatic plants; his classification of the lakes of the district on this basis is corroborated by the new data from echo-sounding.

Since the work described above was carried out, the work of Stocks[4] and Rust[5] has been brought to our notice. Using a different type of non-recording echo-sounder in Kiel Bay, they obtained double and multiple echoes over soft bottoms in contrast to single echoes over hard bottoms, and they put forward an interpretation similar to the one advanced here.

We are much indebted to Messrs. Henry Hughes and Son for the loan of echo-sounding machines and to those scientists who have given help in the work. A fuller account of the surveys is being published elsewhere[6].

[1] Jenkin, B. M., and Mortimer, C. H., NATURE, **142**, 834 (1938).

[2] Mill, H. R., *Geog. J.*, **6**, 46–73, 135–166 (1895).

[3] Pearsall, W. H., *Proc. Roy. Soc.*, B, **92**, 259–84 (1921).

[4] Stocks, T., *Naturwiss.*, **23**, 383–87 (1935).

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OBITUARIES

Prof. F. K. Richtmyer

THE death of Prof. Floyd K. Richtmyer on November 7 has removed a notable figure from scientific circles in the United States. Born in 1881, he graduated at Cornell, most of his academic life being spent as a member of the staff of this same University. His doctoral dissertation was on the subject of photoelectric phenomena, and studies on physical photometry occupied several years of research, during which time he worked under the guidance of E. L. Nichols.

During the War of 1914–18 the urgent need of optical information and instruction in connexion with the development of military instruments and with numerous problems of vision not only led to the rapid growth of the Optical Society in London but also to the foundation of a strong sister society in America. Dr. Richtmyer, appointed in 1918 to a full professorship at Cornell, was a leading figure in the American Society from the beginning, and played a most important part in the subsequent development of the American Institute of Physics.

At various times he was elected to the presidency of the Optical Society of America, the American Physical Society, and the American Association of Physics Teachers. He was associate editor of the *Journal of the Optical Society* from 1917 onwards, and in 1932 he became editor-in-chief of the *Journal* and the *Review of Scientific Instruments*. In the same year, he was elected to the National Academy of Sciences.

Anyone who knows the characteristically friendly meetings of the Optical Society of America, held fairly frequently at various centres in the States, will fully appreciate the careful organization that must have been carried out by a group of which Richtmyer was one of the leading figures. His careful and thorough work as editor of the *Journal* has benefited many who appreciate the high standard which is maintained in its pages. Perhaps he is best known to present-day students of physics through his text-book "Introduction to Modern Physics", in which his great gifts as a teacher and expositor are reflected.

In recent years Richtmyer had many administrative duties at Cornell, that most pleasant of universities with its tree-shaded campus high above the blue waters of the Senaca Lake, but he found time to direct the studies of a class of graduate students in a laboratory where the atmosphere is progressive and stimulating. His chief recent interests lay in the fields of X-rays and spectroscopy, and many papers have borne witness to his thoroughness and care in experimental work.

The many in the United States who relied on Richtmyer's judgment and experience will miss him greatly and their regret will be shared by many in Great Britain who had the privilege of meeting him.

L. C. Martin.

Mr. G. Herbert Nall

The death of Mr. G. Herbert Nall at the age of seventy-nine years occurred on January 14. Mr. Nall was educated at Shrewsbury and at Queen's College, Oxford, where he took a second class in Classical Moderations (1881) and in Lit. Hum. (1884). He was appointed lecturer in Queen's College in 1884 and was classical master and librarian at Westminster during 1886–1922. He was housemaster of the Home Boarders from 1895 and edited many books of the classics for use in schools.

As well as being a classical scholar, Mr. Nall had a bent for natural history which was developed by angling in Great Britain and the Scandinavian countries while he was at Westminster. After he retired he took up the scientific investigation of the life of freshwater fish and in particular of sea trout and trout. Working under the auspices of the Fishery Board for Scotland (now the Fisheries Division of the Scottish Home Department) he applied the technique of scale reading to, and became the recognized authority on, this species. As his work developed, it became clear that the life-story of the sea trout was more complicated and liable to greater variations than that of the salmon, and if a true picture was to be obtained an extended and detailed investigation would be necessary. This laborious task Mr. Nall attacked wholeheartedly. In spite of the size of the undertaking he was never daunted by detail and never thought any trouble too great in order to be sure of his material or of the facts which he elicited from it. His main work was in Scotland, but in addition he did much in England and Wales: he also did not omit Ireland and certain European countries from the scope of his survey. He finished his fortieth paper (publication of which will unfortunately be delayed by the War) for the Scottish fishery department a few minutes before he died. Many other papers by him were published in various journals. His latest work did nothing to disturb his conclusions reached a few years ago, and his "Life of the Sea Trout" will for long remain the standard work on that subject. It is not too much to say that our very complete knowledge of the life-history of the sea trout is due almost entirely to his efforts.

In the death of Mr. Nall, freshwater fishery research in Great Britain, and particularly in Scotland, has lost an enthusiastic and painstaking worker who has accomplished much. In his passing those who knew him have lost a quiet, humble soul and one who never failed to help others.

We regret to announce the death of Sir Gilbert Morgan, O.B.E., F.R.S., formerly director of chemical research, Department of Scientific and Industrial Research, on February 1.

NEWS AND VI

Two Eminent Swedish Chemists

THE year 1840 saw the birth of the two Swedish chemists, Per Theodor Cleve and Lars Fredrik Nilson, the former of whom was born at Stockholm on February 10. Cleve was the son of a merchant, Nilson the son of a farmer of Ostergothland. Both of them became students at the University of Uppsala, where they came under the influence of L. F. Svanberg, who had been the friend of Berzelius. After graduating, and teaching chemistry at Uppsala, Cleve worked in Wurtz's laboratory in Paris, and in the mineralogical laboratory at Stockholm; he then made a geological excursion to the West Indies. After his return home, in 1870 he was given a post at the Stockholm Technical Institute, but on Svanberg's retirement became professor of chemistry at Uppsala and held this position until shortly before his death. Like his contemporary Nilson, he did valuable work on the rare earths, and he showed that scandium, the element discovered by Nilson, was identical with the eka-boron of Mendeléeff. It was partly for his work on the rare earths that he was in 1894 awarded the Davy Medal of the Royal Society. Towards the end of his life he became absorbed in biological studies. For the Chemical Society, of which he was a foreign member, he wrote the memorial lecture on the Swiss chemist J. C. G. de Marignac (1817–94). He died at Uppsala on June 18, 1905.

While Nilson was also known for his investigations on the rare earths, he rendered great service to his country as an agricultural chemist. Farming was in his veins, and he always retained an interest in the prosperity of his native district. After holding the chair of analytical chemistry at Uppsala from 1878 until 1883, he was called to Stockholm as professor of chemistry in the Royal Academy of Agriculture. In the next sixteen years, while engaged on his official duties, he published nearly sixty papers on soils, manures, etc., and his inquiries led to the draining and cultivation of the swamps of Gothland, and to the introduction of the sugar beet. He was elected a foreign member of the Chemical Society in 1888. He died on May 14, 1899, in his fifty-ninth year.

The Parliamentary and Scientific Committee

A MEETING of the Parliamentary and Scientific Committee was held at the House of Commons on January 31. In the absence of the chairman, Captain D. F. Plugge, M.P., the chair was taken by Major H. A. Procter, M.P. The Secretary announced that the following bodies have now definitely agreed to support the new Committee: Association of Scientific Workers, Institute of Chemistry, British Association of Chemists, National Veterinary Medical Association, Institution of Structural Engineers, Institution of

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Nations began in 1920, and in 1921 it became part of the permanent secretariat of the League, with offices in Geneva. The Section consists of three divisions, namely, a directing committee, a consulting committee of experts consisting of the directors of the International Health Office, and an executive staff composed of public health experts, statisticians and clerks who devote their whole time to the work. The Section has done valuable work in the control of epidemics, the standardization of medical procedures, and the collection and publication of medical information.

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engineer to Carlisle, is published describing an effective and easily applied method of thawing frozen water services, when a public A.C. supply is available. In Carlisle, where the voltage is 230, a double-wound single-phase transformer is used, the ratio being 230/12, with a regulating resistance on the primary side and an ammeter scaled 0–250 on the secondary side. The primary is plugged into a 15 amp. radiator socket and the secondary leads are attached to a tap or pipe inside the house and to the stopcock of a neighbouring house. The regulating resistance is adjusted until the secondary current flows through the frozen pipe at about 150 amp. It is found that the normal $\frac{1}{2}$-in. lead service pipe thaws out in five to seven minutes. Mr. Salt says that in cases of sickness where there is no water supply and consequently no kitchen fire or other means of providing hot water, this remedy has been much appreciated.

New Physical Apparatus

Prof. C. J. Overbeck of Evanston University, Illinois, directs attention to some of the recent improvements in apparatus for physical research developed in the United States during the last four years, in a twelve-page illustrated article in the January issue of the *Journal of Scientific Instruments*. He deals with fractionating oil-diffusion pumps of both glass and metal and with the use of sylphon (metal bellows) for producing adjustments in evacuated spaces from outside without interfering with the vacuum. He describes a centrifuge suspended and run in a vacuum, a new apparatus for determining e/m for electrons, and a device for renewing the emitting surface of an oxide cathode. The Bureau of Standards apparatus for attaching to free balloons which signals its records and weighs only 5 lb. is also mentioned. Some examples of the use of Polaroid for stress analysis are given, and a vacuum grating spectrograph for investigating infra-red rotation spectra is described. The advantages of the new synthetic lithium fluoride crystals combined with quartz in a lens doublet, achromatic over a wide range of wave-lengths, are illustrated by spectrograms. References to thirty-one sources of further information are given, and Strong's "Procedures in Experimental Physics" (New York, 1938) is mentioned as of great value for its up-to-date laboratory devices.

Seedlings in Transit: a New Method

Science Service, of Washington, D.C., reports the extensive use of a new and simple method of protecting young seedlings of tomato and cabbage from drying out during transit, which may have considerable importance in Great Britain at the present time. Dr. R. N. Du Puis of Chicago suggested that the plants might survive better if the sphagnum in which the roots were wrapped were moistened with a glycerine solution instead of with water. After encouraging large-scale experiments in 1939, the method was brought into commercial use, more than 75 million seedlings being shipped from the south to the north under these conditions. The new method apparently saved much loss from drying out and is also stated to give protection against fungus troubles.

The National Book Council

It was a wise statesman who said that we must educate our masters, the democracy of to-day, and the National Book Council's latest report, 1938–39, is full of a well-backed forward movement with a new Consultative Committee designed to promote more book-reading. At present, the public libraries are used by about 15 per cent of the population, which remain in ignorance of the chances they have to improve their knowledge, or at least get sound information about their hobbies and the special line of reading they prefer. "Four to Fourteen" for young people has already become a standard bibliography, and "Summer Holiday Reading", a select list of new books, has led to demands beyond the large number printed. Such guides through the present overgrown jungle of books are essential to-day.

The 38-page "Catalogue of Books for the Services" is a good and wisely catholic selection, due to the Council and the Society of Authors acting together. It gives learned and popular theology on one page and on another a choice of thrillers by Dorothy Sayers, science, plays, essays, and fiction, old as well as new. We notice one omission in the judicious section of poetry; Kipling's two early books of soldier jingles are included, but where is the "Collected Verse" of his more mature years? That volume holds many well-known pieces and celebrates the work of our Navy with the "Wet Litany", "Mine Sweepers", "The North Sea Patrol" and other vivid things not easily forgotten. Evacuees, both young and adult, have raised new problems of book-supply, in towns and villages unequal to the demand, and the Council has suggested to the Board of Education sound plans to arouse interest and supply the books needed.

Earthquakes in Greece

Strong earthquakes were experienced last week in the town of Ekaterini at the foot of Mount Olympus on the shores of the Gulf of Salonica in Greece. On the morning of February 1, several tremors and one or two earthquakes occurred to the accompaniment of loud and long-continued underground rumbling. Some houses collapsed. On February 2 the shocks continued, there being eighteen in all. About 120 buildings, including some schools, the law courts and the post office, collapsed or became severely damaged. The casualty numbers have not yet been published. Tents have been erected as temporary dwellings and the postal headquarters are reported to be temporarily in a tent. Medical supplies and anti-typhoid vaccines have been sent from Salonica. It will be remembered that a severe earthquake wrecked several villages in the Chalcidice district of Greece on the night of September 27–28, 1932. The epicentre was then estimated to have been between Salonica and Mount Athos (Nature, October 8, 1932, p. 537), which is to the north-east of the present epicentres.

Earth Tremors in Scotland

Slight earth tremors are reported to have occurred on February 3 at Stirling in Scotland. No damage has been done. The tremors may have been occasioned by slipping along a local fault. Similar tremors were reported from Roslin, near Edinburgh, on February 10, 1934, though the most active region seismically in Scotland is near Comrie in Perthshire, where the slight tremors are considered to be due to slipping along the Highland Boundary Fault system.

Other Recent Earthquakes

SEVERAL severe earth tremors and moderate to strong earthquakes have also been experienced recently in widely separated areas in Italy. On January 25 a severe tremor was felt at Genoa in Italy. This did no damage. On February 1, early in the day, a severe earthquake shock caused considerable damage to the famous cathedral town of Siena in Italy. A less severe shock was felt at Florence, and, presuming it was the same earthquake, the epicentre was close to Siena (lat. 43° 20′ N., long. 11° 20′ E.) On the same morning three shocks were felt in Bucharest, in Rumania. No damage was done. The epicentre of this earthquake was estimated in Bucharest to have been in the Black Sea, five hundred miles east of Bucharest.

Earthquake Recorded on Magnetograph

IN *Earthquake Notes*, the publication of the Eastern Section of the Seismological Society of America (11, Nos. 1 and 2, September 1939), it is stated that the earthquake with epicentre latitude 20·8° N., longitude 66·0° W. on June 12, 1939, which was felt in San Juan, was recorded at the San Juan Magnetic Observatory. The recording was on the magnetograms of both the declination and the horizontal intensity instruments, but there was no trace of a disturbance on the vertical intensity magnetogram.

Francis Amory Septennial Prize

IN compliance with the provisions of the will of the late Francis Amory, the American Academy of Arts and Sciences, as trustee of a fund given by the testator, announces a prize to be known as "The Francis Amory Septennial Prize", to be awarded for conspicuously meritorious work performed during the immediately preceding septennial period, "through experiment, study or otherwise, in the treatment and cure of diseases and derangement of the human sexual generative organs in general, and more especially for the cure, prevention or relief of the retention of urine, cystitis, prostatitis, etc." If any work of quality warrant it, the first award will be made in 1940. The total amount will exceed 10,000 dollars, which may be divided at the discretion of the Academy among several nominees. While formal nominations are not expected and no essays or treatises in direct competition for the prize are desired, suggestions are invited. Communications should reach the Francis Amory Septennial Prize Award Committee not later than May 15, 1940, and should be addressed in care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass., U.S.A.

Paris International Trade Fair

THE thirty-second annual Paris International Trade Fair will be held during May 11–27. The international aspect of the Fair will be developed to an even greater extent this year. Already national sections have been promised from Italy, Holland and Spain, as well as the usual displays from Switzerland, Belgium, etc. In deciding to hold the Fair this year
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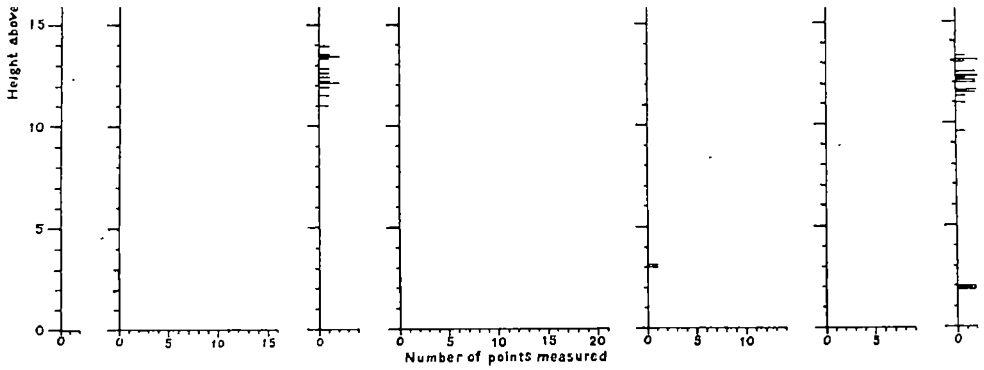

For each date we have chosen as abscissa the number of cases for each given height, and as ordinate the height in kilometres. The time is central European time.

As will be seen, the height was greatest on December 30, 1926, mean 27·7 km., and on January 29, 1932, mean 27·4 km. Of special interest is the fact that the clouds during the night of February 19–20, 1932, were lower down than in the afternoon on February 19, with a difference of 1·6 km. between the means.

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Clarendon Laboratory,
Oxford.
Dec. 28.

[1] "Tables Annuelles", **26**, 13 (1938).

[2] Sargent, *Proc. Roy. Soc.*, A, **139**, 659

[3] Feather, *Proc. Camb. Phil. Soc.*, **34**, 11

[4] Ward and Gray, *Canadian J. Research*,

[5] Roaf, *J. Sci. Inst.*, **17**, 17 (1940).

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RESEARCH ITEMS

Gypsy Luck in Serbia

THE function of luck among Serbian gypsies is formulated as follows by Alexander Petrovič in his continuing study of their beliefs (*J. Gypsy Lore Soc.*, Ser. 3, 19, 1–2; 1940). As they have no personified god, *O Del* (heaven) gives, and *Kar* (lingam) creates, but it is *Baχ* (luck) which gives to man the ability to use what these give and create. Some gypsies believe that Good Luck is a pretty girl, a nymph living in the woods, while Bad Luck is an old man or a toothless old woman, but the Serbian gypsies understand *Baχ* rather as some property of a man, animal or object. He who possesses such a capacity brings luck into the home, and this means health to the household and progress and success in every venture. In a household the wife's luck is the most important; and if a man is unsuccessful in business it may be the fault of his wife, and he may change the luck by being temporarily unfaithful to her. Luck may attach to the bag which a woman carries on her begging expeditions. One woman had had fourteen bags of which only the first was lucky. She always kept a scrap of rag from this one and carried it about with her. Luck may also reside in a whip or an article of clothing. If things or people are not luck bringers they may obtain this power by blessings, as when a wife throws water over her husband as he starts on a journey, saying, "Good luck to thee on thy way", or when a smith begins to use a new hammer and his neighbours say, "May thy hammer be lucky." In the same way certain persons, animals, things may bring bad luck (*Bibaχ*). If a child is unlucky it must be avoided. It must not pour water on you in the morning or talk to you early in the day. It should not approach the anvil, nor should tools be put in its hand; and if a boy it must not become a smith.

Maori Bowls

UNLIKE the Melanesians, the Polynesians never acquired the art of making pottery, but used as receptacles for a wide variety of purposes wood, supplemented to a certain extent by gourds and baskets of totara bark. The general style and perfection of finish of Polynesian and Melanesian wooden bowls vary considerably with different localities. The most perfect come from Hawaii. The Maori bowls show great variety of form, ranging from crudely hollowed out logs to beautifully finished examples, ornamented with carving. Some agree very closely in *motif* with Hawaiian bowls, while others have a distinctly Melanesian character. The collection of Maori bowls in the Auckland Museum, New Zealand, comprises more than forty examples. These have been described, with others not in the collection, but included for comparative purposes, by A. G. Stevenson, assistant ethnologist of the Museum (*Rec. Auckland Inst. Mus.*, 2, 4; 1939). The specimens are divided roughly into five classes mainly according to shape: long, trough-like bowls, short, broad and usually deep bowls, bowls of approximately equal length and breadth, the rim outline being between a square and a circle, bowls in which the bottom internally is flat, while externally they are hemispherical with or without a flat hemispherical base, and in the fifth class two bowls of distinctive type, one almost circular in outline on a small flat oval base, and the other in which the rim is almost circular, but thickens out to a point externally at each end. There are also a number of bowls of unusual form. The bowls, being primarily for use, are not ornamented as a rule, but there are notable exceptions, in which handles or spouts are carved to represent conventionalized human faces. Most of the bowls were of totara wood; but immersion in swamps over a prolonged period often makes exact identification of the wood impossible.

East Indian Gastropods

Drs. Adam and Leloup, in "Résultats scientifiques du Voyage aux Indes Orientales néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique" (Mém. du Musée d'hist. nat. de Belg., Bruxelles, 2, Fasc. 20; 1939), have concluded their study of the gastropods. The present volume deals with pulmonates, scaphopods and bivalves. There are five text figures, seven plates of shells and a map showing localities. The résumé of all the molluscs found, with localities, will be useful to collectors. Altogether nearly six hundred species are listed, but of these only a small number, comprising one amphineuran, one opisthobranch and seven pulmonates are new. This volume contains the last twelve families of pulmonates and one new species, *Ptychodon misoolensis*, which is not described, as an account of it appears elsewhere. The work is systematic and deals with shells and radulæ.

Fossils from the Belgian Ordovician

IN "L'Ordovicien de Sart-Bernard" (Mém. 86, Mus. Roy. d'hist. nat. de Belg., Bruxelles, 1939) E. Maillieux describes the fossils extracted from the Arenigian and Llandeilian strata of Sart-Bernard. There are three plates. From the Arenigian, graptolites, Lingula, trilobites and the Nebalian Lamprocaris are described, and resemble those of other Belgian rocks of the same age. From the Llandeilian one brachiopod, Pionodema, gastropods, lamellibranchs and trilobites are listed. As a whole the species are those peculiar to the Ordovician of Bohemia, except for *Conularia rugulosa*, which occurs also in Normandy, and the two species *Liospira œqualis* and Tentaculites n.sp. which have not been found in Bohemia. The first is a Scottish species. The two Belgian specimens of the second were unfortunately imperfect, so that no specific name is given to them.

Leaf-Growth as a Systematic Feature in Ammocharis

Milne-Redhead and Schweickerdt (*J. Linn. Soc.*, 52; 1939) have re-investigated the systematic position of the genus Ammocharis and related genera, especially Crinum. Whilst some species of

Crinum are readily distinguished by spiral leaf arrangement, others have distichous leaf arrangement as in Ammocharis, but the leaves are always sheathing at the base and are never biflabellately arranged. A peculiar feature of the leaves of Ammocharis, earlier described by Herbert, is that the leaves die down to the bulb but the same leaves resume growth and form new blades the next one or more seasons. The occurrence of this manner of leaf growth in *Crinum Tinneanum, C. heterostylum* and *C. angolense*, and probably in *C. Baumii*, associated with biflabellate leaf arrangement, indicates that these species should be transferred to Ammocharis. The same peculiar feature of growth has been observed in some species of Crinum (subgenus Stenaster), but in these cases the spiral leaf arrangement, sheathing leaf bases and flower characters distinguish them readily from Ammocharis.

Graft Blight of Lilac

AN interesting case of delayed incompatibility between stock and scion of a graft union is described by C. H. Cadman in the *Gardeners' Chronicle* of January 13. Lilac buds upon privet stocks make good growth in the first season, but the foliage becomes rolled and mottled with yellow in the second year of joint growth. Leaves fall from the plant prematurely in subsequent seasons, and the ultimate result is a misshapen bush with thin, spindly shoots. The paper also reviews work by Chester, of the Arnold Arboretum, which shows that the trouble is non-pathogenic, and due solely to the incompatibility between stock and scion of the graft union. Use of common *Syringa vulgaris* for a stock, or burying the Syringa-privet union so that the scion can ultimately form its own roots, are suggested as control measures. It is also possible to propagate the common varieties of lilac by cuttings or layers, though a longer time is necessary to produce plants of saleable size by these methods.

Origin of Lake Toba, North Sumatra

THE history of Lake Toba provides one of the most convincing examples of a genetic connexion between tectonic and volcanic forces. In *De Ingenieur in Ned.-Indië* (4, No. 9, 126–140; Sept. 1939) van Bemmelen discusses the geological and volcanic evolution of the region and shows that the arching-up of a mountain range can, at least in part, result from the rise of magma or migma. The Toba cauldron is situated on the crest of a tumour-like culmination of the Barisan mountain range; it has an area of about 2,000 km.^{2} and a volume of 1,000–2,000 km.^{3}. On the top of the 'tumour' fissure eruptions occurred during the late Pleistocene, with a main paroxysmal phase of acid tuffs, followed by domes and outflows of acid lavas. The tuffs covered an area of 20,000–30,000 km.^{2} in Sumatra and extended to Malaya, where the thickness is still 5–20 ft. The volume of the tuffs is of the same order as that of the cauldron itself, which came into existence during or directly after the main outburst. The cauldron is therefore regarded as a 'super-caldera'. Van Bemmelen considers that a migmatitic batholith rose from the depths until it nearly reached the surface, arching up its cover and finally blowing out the gas-laden contents of its upper part through fissures in the roof. The paper is well illustrated and contains some interesting speculations on the origin of 'Pacific' magmas.

Heat Flow in the Earth's Crust

A. E. BENFIELD (*Proc. Roy. Soc.*, A, 173, 428; 1939) has investigated the outward flow of heat in the earth at a number of points in England by investigating the thermal conductivities of rock specimens taken from boreholes and using a knowledge of the temperature distribution in the same holes. The thermal conductivities were found by placing a carefully prepared rock slice between the ends of a divided brass bar in which heat was flowing; the thermal contact at the interfaces was eliminated by comparing results on specimens of different thickness. The conductivities found range from 0·017 C.G.S. (rock salt) to 0·0014 (shale), and the heat flows calculated vary between 0·7 and $1·5 \times 10^{-6}$ cal. per sec. per cm.^{2}. In the deep bores there was evidence of temperature disturbances consistent with the presence of an ice sheet on the surface up to 9,000 years ago. This necessitates a correction which brings the mean equilibrium heat flow up to $1·4 \times 10^{-6}$ cal. per sec. per cm.^{2}. E. C. Bullard (*Proc. Roy. Soc.*, A, 173, 450; 1939) has made similar conductivity measurements on rocks from deep bores on the Witwatersrand, and L. J. Krige (*ibid.*, 474) has made careful temperature measurements in these bores. The mean heat flow found is $1·2 \times 10^{-6}$ cal. per sec. per cm.^{2}. Both this value and Benfield's similar value in England are lower than those formerly estimated. It appears that there cannot be molten rock under England at a less depth than 20–30 km., while in the South African case, the layer of radioactive granite cannot be thicker than 12 km., and it is probably underlain by an intermediate layer as indicated by certain seismological observations.

Sun's Speed of Galactic Rotation

G. L. CAMM has published an important paper (*Mon. Not. Roy. Astro. Soc.*, 100, 1; November 1939) which leads to a much higher value for the velocity of the sun's galactic rotation than that generally accepted. The method adopted is to find the greatest difference between the angular speeds of rotation of the sun and of other objects in the galaxy, preferably those at great distances from the galactic axis, because their angular speeds would be small. Obviously a lower limit to the angular, and hence to the linear, speed of the sun can be determined in this way. Twenty-six globular clusters were divided into three groups, and it was found that the outer group, ranging from 12,000 to 38,000 parsecs from the galactic axis, appeared to be rotating as a rigid body—a view very difficult to sustain on dynamical grounds. Camm adopts the more reasonable hypothesis that the six clusters forming this group constitute a non-rotating frame, and their apparent motion is really caused by the opposite rotation of the sun. As an apparent angular velocity of — 410 ± 50 km./sec. per 10,000 parsecs for the outer clusters was found, the speed of rotation of the sun is 410 ± 50 km./sec. If it is assumed that the outer clusters are rotating, the absolute linear speed of the sun will exceed 410 km./sec. The other groups ranged from 10,000 to 6,000 parsecs and from 4,000 parsecs to the galactic axis, and it was found that the clusters have a differential motion; quantitative agreement exists between this motion and that of other types of objects. This, with other established facts, helps to confirm Lindblad's theory of sub-systems within the galaxy, each with its own speed of rotation.

THE SUTTON HOO SHIP-BURIAL

THE outbreak of war followed so closely on the gift to the nation of the antiquities from the Saxon ship-burial at Sutton Hoo, Suffolk, by the owner, Mrs. E. M. Pretty, which was announced on August 23, 1939, that there had been little opportunity for detailed examination of most of the objects, nor is any further occasion likely to arise while they are stored against damage. In these circumstances even the partial account to which the current issue of the official publication of the British Museum (Bloomsbury) (*Brit. Mus. Quart.*, 13, 4; 1939) is devoted affords information which will be welcome to archæologists and others, pending further study. A general account of the circumstances and character of the discovery and a description of the gold ornaments by Mr. T. D. Kendrick is followed by notes on the silver by Mr. Ernst Kitzinger, the coins by Mr. Derek Allen and other finds by Mr. T. D. Kendrick, who adds some reflections on the relation of the find to Anglo-Saxon archæology.

Mr. Kendrick points out that while some of the more important objects had been confided to the Museum as excavated, yet many of the notable objects, as, for example, the shield-boss and shield fittings, the helmet and sword have not yet been examined, and only hastily made record-photographs have been available for study.

It will be remembered that the barrow in which this ship was found was the largest of a group of twelve. The form of the ship, as traced, is more of the type of the fourth century type Nydam ship at Kiel than of the type of the Viking ships. The funeral deposit lay amidships under a collapsed wooden shelter in the form of a house with high-pitched roof, and constituted the richest series of grave goods ever found in England.

The richness and rarity of the finds is established by a brief description of their arrangement within the burial chamber measuring about 17 feet long by 8 feet wide. They were disposed H-wise, the horizontal bar corresponding with the keel of the boat and the uprights consisting of accumulations of offerings at the ends of the funeral chamber. At the west end was a standing bowl of bronze with drop handles and in this was a bronze hanging-bowl with elaborate enamelled ornaments, itself containing a wooden object with jewelled mounts that is probably a small stringed musical instrument, and other objects. By these bowls were heads of iron spears and augons, an ironbound wooden bucket, a huge lavishly decorated shield-boss and gilt shield-mounts, a gilt object believed to be a gaming board and among other objects an enormous ceremonial whetstone. Moving eastward, there was found the group of ornamental silver bowls and silver spoons, the remains of a magnificent helmet, the sword with a jewelled hilt of gold and the prodigious array of jewelled gold ornaments, sword harness and the outer trappings of a costly attire including the purse and its contents—gold coins and two ingots. Beyond these jewels were the remains of silver-mounted drinking horns, the great Anastasius and fluted silver dishes and a remarkable collection of miscellaneous objects.

Although the grave furniture was that of a man, there were neither vestiges of the buried body nor the ashes of cremation. Further, there was no single personal ornament of the deceased. Whatever may be the explanation, whether the barrow be cenotaph or grave, it is indubitably the monument of a pagan or semi-pagan royal personage possessed of huge wealth, who on the evidence of coins in his purse died before the first half of the seventh century. He may have been, it is suggested, Redwald, King of East Anglia, Bretwalda of England in 616 who died probably in 625.

The Gold Ornaments. In the fittings of the sword harness and outer apparel of their royal owner, all the pieces are contemporary and the work of one school, possibly of one man—one of the greatest of the many goldsmiths who worked in the cloisonné technique from the latter half of the fifth century onward. The most impressive single object is the massive gold buckle adorned in interlacing ornament and riello inlay, while next in importance comes the purse with its gold frame jewelled with garnets and mosaic glass and enriched with filigree bindings, its flanges, clasp and mountings ornamented in cloisonné and champlevé technique, while a number of minor ornaments are jewelled in garnets only.

The Silver. The outstanding find is the huge dish 27 inches in diameter, with a decoration of mixed ornamental designs. Byzantine control stamps, on which the monogram is of Anastasius, show it to be the work of a silversmith in the period A.D. 491–518. As a whole the silver objects are inferior as works of art to the gold. They belong to a decadent period of Mediterranean art, but within their own class they are important archæological documents. The large dish and the spoons throw new light on early Byzantine metal industry, and the smaller bowls appear to represent the art of certain semi-barbaric border regions of the Byzantine world which yet remain to be more clearly defined.

The Coins. The forty gold coins and two gold ingots found in the purse are the most inartistic objects in the whole burial, but nevertheless are of great importance, for it is on their evidence primarily that the dating of the burial must rest. They are of the denomination of tremissis or third of a solidus, and were all struck at Merovingian mints within or on the borders of France. Of none of the Sutton Hoo coins can it be said definitely that they were struck by a particular king, nor is any one of the moneyers known from historical sources. A rough dating is not before A.D. 600 nor likely to be before 640 or even 670.

Other Finds. Though intrinsically not the most valuable, the great ceremonial whetstone is archæologically the most amazing. Originally it was about 2 ft. long, square in section, the extremities adorned on each face with bearded masks, the stone ends in lobed bosses coloured red and enclosed in a bronze fitting with an empty and apparently useless cup-shaped terminal. Nothing like this stone exists anywhere else. Of equal importance archæologically is the bronze hanging bowl, with a mount from the centre of the interior floor consisting of an oddity in the form of a substantial bronze fish, perched on a rod rising from a circular base, enamelled in the same style as the borders of the exterior mounts.

Sutton Hoo and Anglo-Saxon Archæology. The salient fact of the Sutton Hoo discovery is that, taken as a whole, it is a revelation of a new Pagan Saxon art and archæology in England. It is both unfamiliar and startling. It is more than a pale reflection of the Jutish culture in Kent; it is the independent Golden Age in East Anglia confirming the historical fact of a dawning political ascendancy. Further, it will not be wise henceforth to debate the origins of our Christian art without paying respectful attention to this new evidence from Suffolk.

MINERAL RESOURCES

BY PROF. R. N. RUDMOSE BROWN

IT has been said, with a considerable measure of truth, that one of the decisive factors in war is the accessibility of either side to essential minerals. These include in addition to iron, as the basis of steel, various less widely spread minerals such as the ores of nickel, manganese, titanium, tungsten, etc., and also the ores of copper, zinc, lead, aluminium, etc., and of course coal and above all mineral oil. The statistical summary for the years 1936–38 afforded by this issue of an annual publication* is specially valuable in giving, for most metals, the amount of the ores produced in each territory of the British Empire and also, in many cases, the metal content of the ore.

The import and export for each country, including for some materials not only the crude materials but also the principal derivatives and semi-manufactured materials, are given. Unfortunately, for some important materials detailed figures are not available for all countries in 1938. To take first iron-ore, the world's production in 1938 was 165,000,000 long tons, of which 21,520,000 tons were from the British Empire and 28,700,000 tons from the United States. The other large producers were France with 33,000,000 tons, the U.S.S.R. with 27,000,000 tons and Sweden with 13,700,000 tons. Germany, Austria, Czechoslovakia and Poland between them produced about 16,000,000 tons. Of the great producers only France, with 15,200,000 tons and Sweden with 12,500,000 tons, were great exporters, while of the importers Germany was far ahead of all other lands with 21,500,000 tons. The report does not indicate the sources of this huge import, but Sweden and France were the chief contributors. The United Kingdom imported only 5,100,000 tons of iron-ore: the rest was mainly home produced but a small quantity of pig iron was imported. In 1938 the United States led the world in steel production with 28,000,000 long tons, followed by Germany with 23,000,000 tons, the U.S.S.R. with 17,500,000 tons and the United Kingdom with 14,000,000 tons. With her imports of iron-ore and iron curtailed, the German steel figure must show a great reduction in current times.

Nickel is an essential constituent of certain kinds of steel. Of the total world production in 1938 over 84 per cent came from Canada, another 10 per cent from French New Caledonia, a few tons from the U.S.S.R. and none from Central Europe. The two greatest importers of nickel were the United Kingdom and Germany, the latter probably leading, though different figures disagree. These two countries between them took well over half the world's output. There is now no important source of nickel available to Germany. Chrome ore is more widely spread, but at least forty per cent of the world's output is in the Empire, with South Africa and Rhodesia producing most. Other considerable outputs are in Turkey, Greece, Yugoslavia, Cuba, the Philippine Islands and New Caledonia. Germany used to be the greatest importer of this ore in Europe, producing none herself. Manganese ore is widely found. The Empire has about thirty per cent of the total production and though Germany has none, the U.S.S.R. has a great production and in recent years exported much.

Molybdenum ores are mainly in the United States, but Norway has large resources. Tin and cobalt ores are now almost inaccessible to Germany. One third of the output of lead-ore is from the British Empire, but some is still accessible to Germany from her own lands, the U.S.S.R. and Yugoslavia. Bauxite for aluminium can be obtained from Hungary and Yugoslavia, but supplies will be short.

Tungsten ores are not found abundantly in the Empire outside Burma, nor are there any considerable amounts in Europe outside Portugal. For several years Germany has been a large importer. Copper is another important metal of which the Empire produces about a third of the world's output, and the United States, Chile and the U.S.S.R. much of the remainder. Germany, producing little, used to be a great importer and still has access to Yugoslav copper ore.

Lastly, the position in regard to mineral oil may be noted, without going into details of quality and by-products. In this mineral the Empire is poorly endowed. In 1938 the Empire produced less than three per cent of the world's crude petroleum, the only lands producing a notable amount being Trinidad, the Bahrein Islands and Burma, and none of these produced one per cent of the world's total. The largest producers were the United States with 60 per cent, the U.S.S.R. and Venezuela, each with about 10 per cent of the world's total. Other considerable but much lower producers were Iran (3·8 per cent), Netherlands East Indies (2·7 per cent) and Rumania (2·4 per cent). Outside Rumania there was no noteworthy production in Central Europe: the Polish and Czechoslovak output were quite inconsiderable. The U.S.S.R. was a great exporter, by sea, of petroleum and allied products, but this trade she shared with all the large producers as well as Rumania. Thus even if the United Kingdom has ample sources of mineral oil within reach, it can scarcely be said that Germany is deprived of possible sources of import. There are, of course, problems of transport that may modify the position.

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* The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary 1936–38. Imperial Institute. (H.M. Stationery Office, 1939.) 7*s*. 6*d*. net.

FACSIMILE TRANSMISSION

AN instructive paper, by G. Herrick, describing the progress in the United States of facsimile transmission, that is, the transmission of the printed page, drawings, photographs, documents and original messages by radio or wire telegraphy, appears in the *Electrical Review* of January 19. Certain electrical problems, more commercial than technical, have yet to be solved, and further development makes it necessary to use the best type of paper for recording purposes. Recently when President Roosevelt went to Canadian waters on a fishing trip, on board the U.S. Cruiser *Tuscaloosa*, he received a total of about 50,000 words of news on a facsimile receiver in his office-cabin, while the ship's officers received the same news on a duplicate receiver in the vessel's office.

The information transmitted was gathered by Trans-Radio News, set in type by the Koppel Printing Co. in New York, and broadcast from Cartaret, N.J., by the Finch system of transmission over the regular 780 kc. used by the station WOR of the Mutual Broadcasting Co. The transmissions were received in the afternoon in the *Tuscaloosa*, which reached a maximum distance of 650 miles from the transmitter. As the ship returned and neared New York, the smaller transmitter at the Finch Telecommunications Laboratories in Broadway, New York, took over transmission. For the transmission, alternating current at 110 volts and 60 cycles was used to energize both the transmitter and receiver. One of the difficulties to be overcome in the development of facsimile transmission is the fact that the power stations in different States often vary in frequency.

At present three systems of facsimile transmission of printed material and pictures are being developed. The R.C.A. system is controlled by the Radio Corporation of America and uses what is called 'percussion' recording through varying electrical impulses, which record lines on any grade of paper through the medium of a carbon sheet. The drawback is that it operates at only about three feet an hour.

The system controlled by Finch Telecommunication Laboratories records on special paper that is basically black and coated with an 'eggshell' surface. Across this an electric stylus travels, being regulated by impulses received at standard radio frequencies, or over a telegraph or telephone wire. The stylus draws a hundred lines to the inch and, by oxidizing the surface coating to a greater or lesser degree, records a variety of shades from grey to black.

The system of J. V. L. Hogan, consulting engineer of New York, was used with interesting results at the Toronto Fair by the *Globe-Mail* of that city. This method also employs the stylus principle of recording. Instead of oxidizing a specially coated paper, a series of points that are in contact with specially sensitized paper in rolls delivers varying electrical impulses to the paper and develops the required type of picture as the paper unrolls in the receiver. This system is extremely clear and can record very minute details, such as a photograph of a lace tablecloth or type down to 6-point. All the three differing systems require the material to be transmitted to be placed on a revolving drum, so that it is scanned by a point of light with which is associated a photo-electric tube that reacts to the reflections of light from light and dark substances, varying the impulses sent out.

In the United States, development of this kind of transmission has been delayed by the public and technical interest taken in television. To-day, with television making satisfactory progress, facsimile transmission is being developed rapidly. What the public want is low-cost synchronizers which are both efficient and do not slow down transmission. Some of the synchronizers in use necessitate low speed. The transmissions to the *Tuscaloosa*, for example, were received at three feet an hour.

Photographs both by radio and wire are being sent across the Atlantic at the present time. As an indication of future possibilities, consider the dissemination of news from one city to another by transmitting entire printed pages with illustrations, which would be multiplied by photo-offset printing, and could be sold in the streets within two hours after being sent. This plan envisages the use of wired rather than wireless transmission; technicians engaged in facsimile development suggest that their experiments have indicated that wired facsimile may be less certain than wireless, except in certain sections.

Unlike the television receiver, facsimile apparatus can be built at low cost because it is comparatively simple. The cheapest television sets in the United States cost about £39, but it is believed that a standard facsimile receiver could be constructed to retail at £10.

The Finch organization has recently brought out mobile facsimile transmitters and receivers. Several police motor-cars in Bergen County, New Jersey, just across the Hudson River from New York City, have been equipped with facsimile two-way units that can send and receive alternately. A New York newspaper is experimenting with a motor-car into which is built transmitter, receiver and a dark room. It has a tiny writing space and typewriter for the news man.

The Finch Company has developed a method of utilizing any telephone; strangely enough, the method has been approved by the telephone company, which has rigorous rules against tampering with its lines or equipment. The unit is an inductive coupling and cable. With one end of the cable attached to the transmitting and receiving unit in the motor-car or special truck, the other end of the cable is carried from the kerb into the nearest public or other telephone. The user then calls the telephone operator and says, "Do not interrupt, this wire is being used for a facsimile transmission". The use is thereafter charged at the ordinary telephone rate. During the transmission of news and pictures in this way, it is not necessary to use the telephone, as the office of reception can transmit messages of instruction back to the truck transmitter by writing and having them scanned on its own transmitting drum.

Similar testing of facsimile is being done by the U.S. Army, and the Navy is understood to be increasingly interested in possible use of facsimile for intercommunication between naval ships and messages to and from bases.

PROPAGATION OF RADIO WAVES ALONG THE EARTH

THE mode of propagation of electric waves along the surface of the earth has been investigated theoretically since the earliest days of practical radio communication, and a paper by A. Sommerfeld published in 1909 has since become a classical treatise on this subject. After a period during which attention was mainly confined to the study of wave propagation through the ionosphere, the inception of broadcasting and the practical application of ultra-short waves have caused renewed interest in the problem of propagation along the ground.

Two papers having a direct bearing on this subject have recently been issued by the Institution of Electrical Engineers, and would, in normal circumstances, have been read before a meeting of the Wireless Section on January 3. The first, by Dr. J. S. McPetrie and Miss A. C. Stickland, is entitled "Reflection Curves and Propagation Characteristics of Radio Waves along the Earth's Surface"; it deals with the evaluation of the reflection coefficient of the earth's surface, and then with the application of this knowledge to the study of propagation along the earth. A collection of curves given in this and an earlier paper enables the reflection coefficient for radio waves of any frequency and state of polarization to be determined for any angle of incidence and for various values of electrical constants of the earth.

It is pointed out that the ray theory, on which the reflection from a surface is assumed to be equal to the radiation from an image of the transmitting aerial, is not applicable at grazing incidence unless the heights of the transmitting and receiving aerials are comparable with the wave-length. From an analysis given by K. A. Norton, however, it is deduced that, when the ray theory does not apply, the field at the receiver is equal in most practical cases to the vector addition of two fields; the first is the field given by the simple ray theory while the second, which is independent of the heights of transmitter and receiver, corresponds to the surface wave first postulated by Sommerfeld for vertically polarized waves. The ratio of the magnitudes of the surface wave to the image fields is much less for horizontally than for vertically polarized waves, so that the ray theory is applicable over a wider range of angle of incidence in the former case. As the surface wave is independent of height, this results in the well-known experimental fact that the vertical field from a low transmitting aerial increases in magnitude with height at a much smaller rate than the horizontally polarized field.

The second paper, by Dr. J. S. McPetrie and Mr. J. A. Saxton, describes the results of an experimental investigation of the characteristics within optical range of the propagation overland of radio waves of length 2 and 3 metres. Measurements of the field strength received at various distances from the transmitter confirm the theoretical deduction that, provided the heights of both transmitting and receiving aerials are comparable with the wave-length, the propagation at grazing incidence is the same for both horizontally and vertically polarized waves. In either case, the field strength is proportional to the product of the heights of the transmitter and receiver, and inversely proportional to the square of the distance between them. It was found that, within the optical range of the transmitter, the propagation characteristics corresponded to the condition of a plane rather than a spherical earth, although the varying contours of the path of transmission produced a marked effect on the received field strength. Over a town area, the ratio of the measured to the theoretical field strength was less on a wave-length of 2 metres than on 3 metres.

CAVE FAUNAS

THE specialized cave faunas of the world have been investigated extensively during the last fifty years, and to this prolific literature is now added the results of exploration in the numerous caves of Belgium. Dr. R. Leruth contributes "La Biologie du Domaine Souterrain et la Faune Cavernicole de la Belgique" (Mém. 87. Musée Royal d'histoire naturelle de Belgique, 1939), and in the same series, Mém. 88 by Dr. C. R. Boettger is entitled "Die Subterrane Molluskenfauna Belgiens".

The vast grottoes near Han-sur-Lesse furnished much of the material, although forty-eight subterranean regions were explored. The collections were submitted to specialists for identification. A general section deals with the ecological and geological conditions affecting the Belgian cave faunas, and Dr. Leruth classifies the inhabitants as permanent, temporary or accidental cave-dwellers. The first are completely adapted to their mode of life, the second can live either within or without underground areas, and the third are ill-adapted to cave life and are incapable of breeding there. There are also parasites and scavengers. The terrestrial fauna is poor in species, but the aquatic fauna is relatively rich. Of approximately six hundred species, one genus and sixteen species are new. Bats, mice and rats are the chief mammals, while badgers and foxes penetrate into the smaller caverns. Neither fishes nor amphibia are recorded. Among invertebrates, flatworms, roundworms and ringed worms, arthropods of all kinds and in large numbers, and some molluscs were found.

Dr. Boettger describes the collections of Dr. Leruth and Prof. Séverin. Pisidium is the only lamellibranch genus. Among prosobranchs there are several members of the Hydrobiidæ. Pulmonates are common, especially as the faunas of crevices and underground water channels are included. A blind land snail, *Caecilioides acicula*, and the freshwater prosobranch, *Avenionia bourguignati*, are true cave forms, the latter being a French species recorded for the first time in Belgium.

MINE RESCUE TELEPHONE

Mr. R. C. WOODS, of the Ericsson Telephones, Ltd., London, communicates a description of a mine rescue telephone to the *Ericsson Review* of 1939 (No. 2). The Coal Mines Regulations require owners of mines, to which the regulations apply, to make definite provision for rescue work in mines after an explosion, fire or other accident. Telephone communication between the rescue brigade and its base is of great importance. Ericsson Telephones, Ltd., in collaboration with the Mines Department Testing Station, have constructed a mine rescue telephone which was officially tested last year, after which the production was immediately undertaken.

When a rescue corps is called to a mine, a base is immediately established in fresh air but as near as possible to the zone where the air is so foul as to be unbreathable. As the team of from eight to five men will be wearing breathing apparatus, speech is impracticable and communication has to be established by other means. Uniform codes of signals are prescribed, one for use between members of a brigade, for which each man carries a bulb hooter, and one for electric signalling. While the existing mine telephone system may provide for the telephone communication between the rescue corps and the base, it cannot be depended on and it would rarely prove convenient, speech not being practicable owing to the breathing apparatus, both of which are vital factors in such an apparatus, which only comes into use in severe conditions.

The mine rescue apparatus constructed by Ericsson's consists of two units, a base station and an advance station, connected continuously by a light but tough cable. In the constructional features of the design, particular attention has been paid to strength and low weight.

Signals in both directions are effected by a buzzer, using a special code. The note is distinct and penetrating, the high frequency avoiding any chance of confusion with other noises. In addition, the base party can speak to the advance party, both speech and signals being received on the loud-speaker at the advance station unit. After much consideration it was decided to limit to key signals only communications from the advanced party. If both-way speech were provided, the additional equipment would appreciably reduce the mobility of the advance party.

The base station unit is about 24 cm. square with a depth of 16 cm. On the front of it there is fitted a sensitive transmitter, a small loud-speaking receiver and a high-frequency buzzer. When the keys are in their normal position, the loud-speaking receiver is connected directly to the trailing cable and hence to the advance station unit. Any signal sent out by the advance party is thus immediately reproduced by this receiver. The batteries are of the ordinary cycle lamp type so that replacements are readily obtainable. Battery voltages are 6 and 3 volts respectively for the use of the base and advance party units.

Safe operation in dangerous atmospheres is a feature of this system. If during rescue operations it is desired to extend beyond the first cable length, a further advance party instrument can be connected by a simple plug and the circuit transferred from the first to the second unit.

SEVENTY YEARS AGO

Nature, vol. 1, February 10, 1870

The Royal Commission on Science

"The Council of the British Association for the Advancement of Science was received on Friday last by Earl de Grey, Lord President of the Council, as a deputation to urge on the Government the issuing of a Royal Commission to inquire into the state of Science in England.

"The main points for a Royal Commission to throw light upon are these. First, is it right that science should be aided by the State ? Secondly, is the aid now given exactly what is needed—neither too much nor too little ? Thirdly, the degree and direction in which science should become a State business having been settled, what will be the best organisation for the purpose ? Not one of these points has ever yet been thoroughly considered in England."

Microscopical Investigation of Meteorites

Prof. N. S. Maskelyne, of the British Museum, provided a full abstract of his recent paper on this subject presented to the Royal Society. Transparent sections of small fragments cut from meteorites were studied under the microscope. They showed that "a meteorite has passed through changes and that it has had a history of which some of the facts are written in legible characters on the meteorite itself and, one finds, that it is not difficult roughly to classify meteorites according to the variety of their structure. One also recognises constantly recurring minerals ; but the method affords no means of determining what these are". The chief use of the microscope was as a means of sorting out the various minerals from "the bruised débris of a part of the meteorite", investigating each by the goniometer and by analysis, "and finally returning to the section to identify the actual minerals present".

The Work of the Sea

In an article by C. W. Whitaker, M. Quenault is quoted as concluding, with regard to the depression of the land : "One gathers from all these evidences, that the movement, since the eighth century, has been about two metres a century. If it continues at the same rate for ten centuries more, the peninsula of Cotentin will be an island and all the ports of La Manche will be destroyed. Some centuries later and Paris will be a seaport, waiting only to be submerged in a score of centuries. Thus in a period, less than half as long as that during which the pyramids of Egypt have braved the ravages of time. Paris itself—if it is not burned down during one of the revolutions of its inhabitants, as amiable and *spiritual* as they are inconsistent—Paris will probably be engulphed in the Atlantic, a master before whom the intractable Parisian must haul down his flag. Let him take warning !"

With reference to the "situation" at the Paris Observatory [see Nature of February 3, 1939, p. 198], the action "of the French Government has been of the promptest and M. Le Verrier is no longer Director. This step indicates very clearly—too clearly we fear—the strength of the case put before the Minister of Public Instruction. . . . The document was signed by Villarceau, Marié-Davy, Wolf and Loewy. . . .

It is to be sincerely hoped that M. Le Verrier may be able yet to do service to astronomy, in some other capacity, some position where his great talents alone will be called into play."

"A new office has been constituted under the Public Works Department and Mr. Douglas Galton, C.B., F.R.S., has been appointed to it with the title of Director of Works and Buildings. We may congratulate ourselves that our public building will be looked after by one so eminently qualified by his high scientific attainments and great experience in such matters."

M. Vérard de Sainte-Anne read a memoir before the Paris Academy of Sciences on a project for establishing communication between France and England. The author proposed the establishment of a railway bridge, either open or tubular, across the Straits of Dover.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Commissioned Ordnance Mechanical Engineers in the Indian Army Ordnance Corps—The Secretary, Military Department, India Office, Whitehall, S.W.1 (quoting 'O.M.E. Recruitment') (February 14).

Director for the British Institute in Milan—The British Council, 3 Hanover Street, W.1 (quoting 'Milan') (February 15).

Research Officer for Bacteriological work—The Secretary, Agricultural Research Council, 6a Dean's Yard, Westminster, S.W.1 (March 31).

Radio Engineers by the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), War Office, Hobart House, Grosvenor Place, S.W.1.

Mechanical and Automobile Engineers by the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), War Office, Hobart House, Grosvenor Place, S.W.1.

Engineer and Ship Surveyor for the Department of the Surveyor-General of Ships, Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9066).

Temporary Forecasters, Grade II (Male), in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March 1939. Pp. viii+172+15 plates. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [221

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CIVILIZATION AND THE RIGHTS OF MAN

MUCH has been said and written recently on the causes of the present conflict between Germany and the Allies and the conditions of peace, but most of it has been from the point of view of national expediency and little from that of the history of civilization or the future of mankind. In his two latest books—"The Fate of *Homo sapiens*" and "The New World Order"—Mr. H. G. Wells takes an eagle-eyed view of the world of man, as he did in his "Outline of History", and brings his critical mind to bear upon what he sees. With a few other students of history he realizes that the scientific method of inquiry can be profitably applied to political and social problems, as it is to other aspects of biological development. In the struggle for existence of all forms of life, many factors are involved; and the aim of scientific investigation is to discover their nature and influence. The history of civilization shows that the chief causes of war have been migratory movements—represented in modern times by access to natural resources and the claim for *Lebensraum*—aggressive nationalism, racial lust and religious hatred.

In the natural instincts which have led to struggles between groups of peoples, mankind is the same as it was at the beginning of civilization six thousand years ago. There has been great increase of knowledge but not a corresponding increase of wisdom in the use of it. If an individual or a nation has the will to assert a claim by force, he can acquire in an open market whatever power he is prepared to pay for and use. In a civilized community, citizens protect themselves from such dangerous disturbers of the peace by means of a police force; but there is no similar force to prevent breaches of the world's order by truculent nations, and no international court whose judgments upon disputes are accepted as final.

If the civilized world is to survive, the hour has come when measures will have to be devised to control the "gangster" element in human nature, whenever or wherever it manifests itself. Authority to exercise such power will come only when nations believe that it is in their own interest to combine for the common good of the whole community of mankind. How this end can be attained, and the changes which will have to be made in social and political structures in order to achieve it, signify reconstruction of existing systems in a manner which may rightly be described as revolutionary. The aim of such a revolution is not, however, to readjust class relationships, but to create a world commonwealth of free peoples conscious of their responsibilities one to another, and accepting the principle of "Live and let live" rather than that of "Lie and let lie", which is often an excuse for political diplomacy.

This is the type of revolution which Mr. Wells foresees, if civilization is to be saved from self-destruction. He urges that "It is the system of nationalistic individualism and unco-ordinated enterprise that is the world's disease"; and that the old foundations of the system have proved unable to support the ponderous structure which has been built upon them. To strengthen one part by political balance of power or alliances makes other parts of the structure relatively weaker, with the result that the stability of the whole suffers. Mr. Wells has, therefore, no sympathy with the movement for the federation of a number of European States, unless it is deliberately made the basis of a system designed ultimately to comprehend all the peoples of the world.

There is nothing new in the spirit of this intention. The philosophy of the Stoics included the principle of the brotherhood of man and the merging of all nationalities in a cosmopolitan citizenship. Christianity adopted the same ethical doctrine, and still pursues it; yet neither in economic nor in political spheres are national policies or actions determined by it. After nearly two thousand years of teaching peace on earth, good will towards men, this principle of all systems of ethics does not enter into the field of practical politics of Christian nations any more than it does in other communities. It may be that a world commonwealth of nations is just as far off as a world fellowship of religious faiths, but that does not make the ideal less worthy of effort to attain it. The mines and torpedoes which lie in the track of civilization at the present time make it more necessary now than ever it was for navigators to be guided by a single light, instead of each ship of State, or convoy, following a course which must cross the tracks of others and lead to collisions.

Though, in the past, war has played a part in the formation of certain groups, it represents only one phase in the development of civilization. It is true that civilization has developed through individual peoples, as, historically speaking, mankind has been organized on that basis, but we, as heirs of the ages—to use a trite but expressive phrase in this connexion—are not interested in the survival of these peoples, except in so far as they have contributed to the general advancement of the human race. The trend of cultural achievement in the advancement of mankind has been to operate through larger and larger unities—tribe, people, nation, confederacy—eliminating war and the struggle for existence as physical facts, and relying more and more on the struggle for existence between ideas.

It is towards such a world commonwealth, in which each nation can be free to follow its own course of cultural development, that Mr. Wells would direct civilized thought. It may be held that this conception represents merely a reversion to primitive social structures; but the difference is in the extent of outlook. Whereas, in the primitive form, the sense of responsibility embraces the members of the same blood-kin only, or those of the local group within which the members are more or less intimately acquainted, in a modern society it may reach out to embrace all members of a great nation, and possibly, when conflicting creeds and ideals agree to sink their differences, it may extend to all men of good will, to whom the dignity of man as an individual entity transcends racial and political boundaries.

When, if ever, this comes to pass, it will be possible to gauge how far mankind has advanced along the road of ethical as well as material progress. To many, the way seems long to go. The urge of nationalism and its ideals, combined with belief in might as the sole arbiter of right, has diverted the thoughts of peoples away from the main stream of human progress into narrower channels in which rocks and rapids threaten at every turn to shipwreck all that is best in civilization.

In what is conceived to be the highest type of civilization to-day, certain ethical and humane sentiments, such as those of truth and righteousness, justice and mercy, and sympathy with the weak and suffering, are possessed and practised by a greater number of the community than ever before. These high attributes of human nature have survived the ages of violence, cruelty and rapine which have disgraced European history, and by which the recrudescence in our own times will be remembered. In spite of these degrading influences, there has been an increase in the true, the humane and the just, and the standards of conduct towards others have become ethically higher, until now no people or nation which reverts to such methods can claim to be in the van of modern civilization. In so far as the present conflict is one of ideals, it may fairly be said that those of the Allies represent a far higher ethical standard than exists at present in Germany.

Freedom of thought and speech, belief and investigation, subject only to the recognition of the same liberty on the part of others, is threatened by the new tyrannies which, through their aggressive militarism and economic nationalism run mad, seek to reduce the citizen to a soulless unit and a condition of moral and intellectual servitude. The existence of economic antagonism and military rivalries among nations is as grave a danger to scientific thought and investigation, upon which so many material achievements are based, as it is to the general progress of civilized life. Science must, therefore, stand for high human values, as against slavery of the spirit of man, if civilization is to be preserved from the dangers which now threaten it.

There are certain fundamental human rights the recognition of which would do much to promote a sense of common interest among the peoples of the world. Mr. Wells gives the first draft of such a Declaration of the Rights of Man in his "New World Order"; and the *Daily Herald* is submitting it to free and wide discussion with the view of constructing a new charter to represent man's just claims in a modern society. The intention is eventually to produce a Declaration which will represent world-wide opinion, and will crystallize the thoughts of men and women of all ranks and of all races who believe in the essential greatness of mankind. It is hoped that such a Declaration at the present epoch may have valuable consequences in shaping the structure of human society to the benefit of mankind.

Representatives of science are invited, with those interested in other fields of progressive life, to assist in making the final form of the Declaration a worthy and enduring statement of human needs. The time has come for the assertion of the rights of scientific and other intellectual workers in modern life, in view of the conditions of cruelty and suppression to which their work is now subject in some countries. Such a Declaration would insist that creative ideas are the essence of progressive thought and achievement in science, as in art and literature; and that to make them subversive to the principles of any social doctrine or political system is to restrain the expansion of the human mind and its means of expression. Research can be organized and team-work be profitably applied to solve particular problems, but the true heart of science is in original independent thought; and this can neither be created nor regimented by political authority.

It has been suggested that a charter should be framed embodying these and other principles of liberty of thought, and freedom from the frustration by authority, which have long been assumed to be characteristic of scientific activity. Little encouragement has been given to this idea in scientific circles, otherwise the Society for the Protection of Science and Learning, or the British Association's Division for Social and International Relations of Science, would no doubt have produced such a charter. The world of science is international in its constitution and aims, and citizenship can be claimed in it by men and women of any race or nationality who will respect the principles implied in the pursuit of scientific truth and endeavour to contribute to the advancement of natural knowledge by following them. The Declaration of the Rights of Man which should emerge from the discussion organized by the *Daily Herald* will no doubt include these principles, among others which may be justly claimed by all the citizens of the modern world.

PROPERTIES OF MATTER IN BULK

Statistical Thermodynamics

A Version of Statistical Mechanics for Students of Physics and Chemistry. By Prof. R. H. Fowler and Dr. E. A. Guggenheim. Pp. x + 693. (Cambridge: At the University Press, 1939). 40*s.* net.

PROF. R. H. FOWLER, with the able assistance of Dr. E. A. Guggenheim, has produced a book which will serve in many respects as a third edition of his "Statistical Mechanics", but which does not supersede the former work entirely. The present book is written with rather a different aim in view. The first edition of "Statistical Mechanics" gives the impression that the author's interest was centred primarily on a new and elegant mathematical technique, the "method of steepest descents", which could be applied with profit to a very large number of physical problems. The second edition represents a transition stage, with more emphasis on the physical problems and less on the principles of statistical mechanics. In the present work the shift of emphasis is complete. It is a book, admittedly written from a mathematical point of view, about the properties of matter in bulk. Theorems of statistical mechanics and of thermodynamics are both used, as may be convenient, to discuss the problems under consideration; once the laws of thermodynamics and their connexion with statistical quantities have been derived, full use is made of them whenever it seems advantageous. It was this fact which suggested the title "Statistical Thermodynamics" given to the book.

In accordance with the utilitarian nature of the book, no discussion is given of the truth of the fundamental axioms of statistical mechanics; these are merely stated, and the reader is referred to recent books on the foundations, such as that by Tolman. Since, moreover, it is intended primarily for students of physical chemistry (or, may we say, chemical physics), the chapters which appeared in the old book about astrophysical and atmospheric problems are omitted.

After the general methods of statistical mechanics have been discussed, the book opens with a discussion of the specific heats of perfect gases, which has been brought thoroughly up to date. Chapters on crystals and on chemical equilibria follow, and then chapters on imperfect gases, liquids, and the theory of condensation. Solutions of electrolytes, adsorbed surface layers, elementary electron theory of metals, lattice imperfections and order-disorder in crystals, and dielectric and magnetic properties of matter in bulk are other subjects treated. There is also a chapter on chemical kinetics, which, although not a subject which can be included under the heading of the properties of matter in equilibrium, is nevertheless a field in which the methods of statistical mechanics have been applied extensively to calculate the number of molecules in the activated state.

A study of the book and in particular a comparison with Prof. Fowler's earlier treatise is interesting especially in reminding the reader of the subjects in this field which have received the most attention from theoretical physicists during the last four years. There are in particular the complexities of the problem of the liquid state, which resist as obstinately as ever all attempts to write down a partition function even for the simplest liquid. The authors give an account of the various more or less crude models which have been proposed to describe liquids, and they also develop the theory of Mayer, Born and others about condensation.

The recent discovery of the existence of alloys in which an ordered superlattice gradually disappears as the temperature is raised has provided an invigorating incentive to mathematical research on what are known as co-operative phenomena. By this term is meant the variation with temperature of the equilibrium state of a body in which the forces holding each molecule in some normal or ordered position depend on the number of its neighbours which are themselves in ordered positions. In a sense the fusion of a solid may be regarded as a co-operative phenomenon, but the order-disorder transition in alloys presents a problem which is much more amenable to mathematical treatment, because in an alloy each atom has the choice only of an ordered or a disordered position, instead of the infinite number of positions which are possible for a molecule in a liquid.

The earliest mathematical treatment of any phenomenon of this type is Weiss's theory of ferromagnetism and its disappearance above the Curie point; but the further development of the subject as a problem in statistical mechanics has been hindered by the difficulty of giving a satisfactory account, from the point of view of quantum mechanics, of the interaction between the elementary magnets. The difficulty arises partly from the fact that the elementary magnets, namely, the electrons, do not stay in the neighbourhood of definite lattice points but wander through the crystal. In alloys, on the other hand, in spite of the primitive state of our knowledge of metallic cohesion, it is a reasonable hypothesis that the simple assumption of a law of force between neighbours is a sufficient basis for a theoretical attack on the qualitative aspects of the problem. This, at any rate, is the point of view taken in the book under review, and a very full account is given of the various theoretical attempts to set up a partition function for the system, and to find out whether there should be a phase change at the transition point, or whether only the specific heat or even its first derivative is discontinuous.

The present reviewer welcomes the appearance for the first time of an account of the Wagner-Schottky theory of lattice defects in crystals in thermodynamical equilibrium. Apart from its interest in explaining ionic conduction in crystals, and the importance of the concept for the theory of chemical reactions in solids, the theory has a considerable didactic value. In teaching statistical mechanics to students, it is often advisable to put off the study of gases for as long as possible, because of the difficulty in evaluating the chemical constant, and hence the entropy of a gas, without a much deeper incursion into quantum mechanics than the average student can follow. Interstitial atoms or vacant lattice points in a crystal have many of the properties of a gas, but since one can count directly the number of ways in which they can be arranged, expressions for their entropy and free energy can be written down without any appeal to quantum mechanics at all. The present reviewer has found that the subject forms an excellent introduction to the study of chemical equilibria, in the further development of which there is a good deal that the average student has to take for granted.

Readers of Prof. Fowler's earlier books will not need to be assured of the thoroughness with which the work of revision has been done, or of the masterly and complete mathematical treatment of the physical problems which are discussed. Students approaching the subject without much mathematical knowledge will, we think, find it easier than in the previous books to discover the formulæ that they want and to understand the steps by which the formulæ are obtained. The book is written with the needs of practical workers in physics and chemistry in mind, and it is a remarkable achievement to produce a treatise so eminently useful without sacrificing mathematical rigour or completeness in any way.

N. F. MOTT.

PRINCIPLES AND PRACTICE OF EDUCATION

Knowledge and Character
By Dr. Maxwell Garnett. Pp. xii + 358. (Cambridge: At the University Press, 1939.) 18*s*. net.

DR. MAXWELL GARNETT in this book approaches the problems of moral education from the point of view of physiology and experimental psychology. Time was when recourse to scientific method would have meant that the author was committed to a materialistic and determinist interpretation of the mental and moral life. But that is no longer the case. Science has shed almost every trace of *a priori* dogmatism, and we find Dr. Garnett frankly advocating the hypothesis of interaction between mind and body as the most reasonable explanation of the facts. True, he raises a good many problems of a speculative order which the limits of his space do not permit him to discuss fully. He ranges in the course of his argument over the theory of knowledge and of being, touching also in highly suggestive ways on questions of religion and the ultimate aim of life. We find him speaking of what are strictly psycho-physical generalizations, such as the five formulated in the earlier chapters, and summarized collectively on p. 273, as though they were laws of *thought*; and a good deal of his physiological theory of neurograms, each of which corresponds with varying complexity to a concomitant mental process, is of the nature of highly inferential construction from data that are strictly psychological. Indeed the concept of correspondence which occurs very frequently in these pages seems to us to stand in need of a good deal of detailed explanation. It may well be questioned whether the method of explaining psychological facts by speculative physiological deductions from the very facts to be explained has sufficient logical validity.

An adequate criticism of the book would require a combination of expert knowledge in physiology, psychology and philosophy. The present reviewer can claim competence only in the last-mentioned of the three. In regard to the physiological sections he can but note how carefully documented is the evidence from the highest authorities such as Head and Sherrington. In psychology, Dr. Garnett naturally draws upon his own work in collaboration with Spearman. His mastery of the technicalities of factor analysis, and especially of the *g*-factor, in the mental outfit of the individual, is strikingly displayed in Chapter vii, and should prove most fruitful in the shaping of educational theory.

On the broader speculative issues handled in the last half of the volume, Dr. Garnett's views will doubtless cause some searchings of heart among philosophers. One of the points most open to question is his theory that the soul acts only through the will, and by way of selection and choice between alternative neurograms. It is a little difficult to understand the status of the soul, which seems to be of the nature of a pure ego, in itself unaffected by the development of character, and yet capable of functioning without any physiological correlate. Indeed, in one very interesting note, Dr. Garnett suggests the possibility of direct communion between souls, and again between the human soul and God. Such a relationship is presumably purely spiritual. "It is not inconceivable," he says (p. 162, note 1), "that another Soul—God perhaps—or other souls should communicate directly with our souls. In such a case it is possible to imagine that the other soul which communicates with mine does so directly, soul to soul, or indirectly by first causing excitement in my brain. Since, however, my own soul cannot create, but only re-inforce, excitement in my brain, it is not to be supposed that any other human soul has power to *create* excitement in my brain; but we may choose to suppose that God has it, and sometimes exercises it. It is, however, simpler, and therefore preferable, to suppose that all purely psychical communications proceed direct from soul to soul."

In another respect, the adoption of a strictly scientific approach leads Dr. Garnett to lay stress on the importance of psycho-physical generalizations in the training of moral character. As he rightly says, "it is the faith of every science that an unlimited number of phenomena can be comprehended in terms of a limited number of such propositions, principles, or 'laws'. The phenomena are explained as particular examples of the working of general 'laws'." (p. 8).

Now this method is certainly very fruitful when we are dealing with character and conduct on their lower and less complex levels. Then these general rules and laws of habitual behaviour come predominantly into play. But on the higher levels of thought and action, purposes and interests are increasingly unique and individual, defying reduction to any combination of generalities. It is to Dr. Garnett's credit that he frankly recognizes this limitation of scientific method in its application to education. He puts great stress on the development of personality in the individual, who is moved, in William James's phrase, by "partial purposes and private ends". This is all the more suggestive because of Dr. Garnett's frank adoption of the Christian hypothesis (Chapter xv) as making more sense of human experience than any other. Christian saints and teachers have always insisted that the element of self-love is ineradicable from human nature, even in the state of perfect consummation in communion with God. Spiritual growth consists in the passage from self-love, detached from love of God, to self-love in and through love of God. It is interesting to find repeated confirmation of this cardinal religious tenet in the physiological and psychological positions advocated by Dr. Garnett.

Enough has been said to show the wide range of interest in this volume. Dr. Garnett brings to his task long experience in educational administration, a wide knowledge of human affairs and a humanistic culture that is rare in a trained man of science. The result is a book that throws light both on educational principles and on their practical applications, as, for example, in the Spens Report, to which frequent reference is made throughout the volume. There is an excellent index.

W. G. DE BURGH.

SIR JAMES FRAZER'S NOTEBOOKS

The Native Races of America

A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Notebooks of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. (Anthologia Anthropologica.) Pp. x+352. (London: Percy Lund, Humphries and Co., Ltd., 1939.) 35*s*.

THE issue of the fourth and concluding volume of extracts from the notebooks of Sir James Frazer, edited by Mr. R. A. Downie, must inevitably provoke certain general reflections on the work as a whole. Among these, the first to emerge in the minds of all will be admiration for Sir James's genius, mingled with a profound amazement at the stupendous energy and industry which have extracted and digested the material apt to his purpose from so vast a literature as has been sampled in these four volumes. With a penetrating insight into the working of what might be termed the 'traditional' mind of primitive man, he has disentangled from an enormous body of recorded fact the significant threads in the evolutionary development of religious beliefs and emotional reactions in a vast variety of forms of the social environment. The task has demanded a logical grasp and a power of generalization which have been equalled by the lucidity and persuasive eloquence with which the argument has been presented to the world. The supplementary evidence contained in "Anthologia Anthropologica" is no less an integral part of the monument, which is Sir James Frazer's life work, than "The Golden Bough" or "Totemism". For its publication we are deeply indebted to Lady Frazer and the editor, to both of whom Sir James pays well-deserved and graceful tribute in a foreword.

It will be remembered that the principle upon which the contents of these volumes have been selected is that recent sources have been set aside, with a few exceptions, and only the older, less accessible and less known material has been included. Hence from the nature of the material, the extracts present a view of primitive man unsophisticated and as he was to be found in the remoter parts of the world between the sixteenth and latter parts of the nineteenth centuries, but more especially in the eighteenth and nineteenth centuries. The conditions in which he was observed by those writers from whom these extracts have been drawn have long passed away; and their record correspondingly is of enhanced significance for the anthropologist.

This consideration is of special application in estimating the value and interest of the extracts which deal with America. They are records, of which some were familiar to a past generation of anthropologists, but with the development of new methods and a new outlook in America, now receive less consideration than they deserve. Such are for example H. Rink and Hall on the Eskimo, and the valuable reports over a series of years of the Ethnographical Survey of Canada, unfortunately interred in the Annual Reports of the British Association. Here also is much of the early work of F. Boas on the Kwakiute of the north-west, of J. Teit on the Thompson Indians of British Columbia, and the valuable Reports of the Jesup North Pacific Expedition. It is, however, in its earliest records that the literature of indigenous America is at its best, and although "The Golden Bough" has drawn liberally on these sources, it has been possible to add much from Sahagun, Valdes, Herrera, and Ariaga on the extirpation of idolatry in Peru, and other early

Spanish writers who were in a position to obtain or give first-hand information on pre-conquest or early post-conquest peoples in Central or South America—material of which anthropologists, with the exception of those known specifically as 'Americanists', make too little use.

The records of American peoples, whether early or late, from which these extracts are taken, are of even greater interest than those relating to other parts of the world. Outside America, except for isolated instances, such as the Tasmanians, the people still exist, though their conditions of existence have suffered modification. In North America, excepting in the remote north-west and among the Eskimo, as Harlan I. Smith pointed out some years ago, it is becoming increasingly necessary to employ the methods of the archæologist in ethnographical investigation. The transfer of the Indians to reservations has sapped or destroyed their culture, except where special reasons, mostly economic, artificially prolong an attenuated existence. Recent ethnographical studies have had to depend upon the memories of a few rapidly disappearing elders among the tribesmen. Hence the value of even the scantiest record of earlier conditions.

A map of "Some Indian Tribes of North America" is included. It is too incomplete to be of much value as a guide to the text and is unworthy of the care which has been lavished on the production of this and the three earlier volumes.

The fifty-five notebooks containing the material, written in Sir James Frazer's own hand, and the product of more than fifty-two years of unremitting labour, from which the extracts appearing in the four volumes of "Anthologia Anthropologica" have been taken, have now been accepted for custody by the British Museum (Bloomsbury).

THE PLANT ALKALOIDS

The Plant Alkaloids
By Dr. Thomas Anderson Henry. Third edition. Pp viii + 689. (London: J. and A. Churchill, Ltd., 1939.) 42*s*.

IN spite of the fact that modern fashions in chemical research have inclined towards the hormones and vitamins, much work has been accomplished during the past twenty years in the field of the plant alkaloids. This fact is reflected in the third edition of Henry's "Plant Alkaloids", which to all intents and purposes is a completely new book. It bears little relationship to the second edition published in 1924, although the arrangement of the material on the basis of a chemical classification according to the nuclear structure has been retained. Slight deviations from this plan occur where important biological relationships would be obscured by a slavish adherence to such a plan. On the other hand, the reader is warned against placing too much reliance on such relationships in considering possible structures of new alkaloids with the reminder that sparteine, long known as the characteristic alkaloid of broom tops (Leguminosæ), has also been found to occur in *Anabasis aphylla* (Cheniopodiaceæ) and as an associate of chelidonine in the greater celandine (Papaveraceæ).

The fascinating problem of the biogenesis of alkaloids is illustrated by reference to many of the experiments conducted by chemists under so-called physiological conditions—at temperatures about 25° C., in presence of feeble acidity and using materials known to occur or to be capable of formation in the plant. Those of Robinson involving the conversion of lysine and arginine into hygrine, and of Schopf and others on the synthesis of tropinone, pelletierine and lobelanine are typical examples. Such work necessarily follows progress in the correct diagnosis of molecular structure.

Special reference should be made to the section on the alkaloids of cinchona. Numerous and complicated as they are, the efforts at chemical diagnosis have been successful and in many cases confirmed by synthesis. The complex problems of stereochemistry have been solved and it is natural that the literature covering this field is very voluminous. Dr. Henry, himself an outstanding figure in this work, has managed to condense the matter available into digestible proportions. There is no better summary of the cinchona alkaloids than that found within the pages of this volume.

Probably no other department of chemical endeavour has given rise to so much controversy as the structure of certain of the alkaloids. Mention of morphine, strychnine and berberine emphasizes this point. The author has given a critical account of all the important work on alkaloidal structures and has managed to escape being didactic, whilst giving reasoned assistance in the formation of opinion as to the merits and demerits of opposing contentions. In this respect the book should receive a welcome from all concerned, from the research worker to the honours student.

The pharmacology of the alkaloids has been adequately reviewed, much of the exact work being of recent date. This section has been read critically by Dr. White and will be useful alike to the chemist and the pharmacologist. The importance of such work reaches beyond the confines of the 'pure' pharmacologist on account of the comparatively modern endeavours to relate pharmacological action with chemical and physical properties and thus with molecular structure; that is, chemotherapy in its widest sense not limited by the hampering definition of being concerned only with those products which attack an invading organism. Dr. Henry has directed attention to this aspect of the problem by reference to the work on esterified amino-alcohols as cocaine substitutes in local anæsthesia and to the modified cinchona alkaloids. Such work attracts both the pharmacologist and the chemist, and hence it is a great convenience and help to have chemical and pharmacological summaries and references treated in a single book.

Even a work of this size is inadequate to deal with all facts of alkaloidal work, and some selection was imperative. In this connexion Dr. Henry has rightly chosen to deal very briefly with the methods of extraction from the plants and has been content to refer to the more important papers concerned with the chemical and biological determination in plants and plant extracts. Sufficient references are included to help those interested in this aspect of the subject.

The value of such a work as this depends largely upon the bibliography: this is remarkably complete and includes references published little previous to the date of issue. Numerous tests for the presence or absence of references were made, but in no case was the book found wanting.

In conclusion, this work forms a perfect reference book in its subject, and even if criticism were possible, to criticize would be an act of sheer ingratitude. The enormous amount of work involved in the collection, correlation and interpretation of the huge mass of material available represents scholarship of a high order.

W. H. LINNELL.

STRUCTURE AND FUNCTION

Life and Living

By Frederic Wood Jones. Pp. x + 268. (London: Kegan Paul and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THOSE who have had the opportunity of admiring Prof. Wood Jones's facility and effectiveness as a lecturer will be grateful to him for the publication in a book of some of his recent public lectures. His style of lecturing is particularly well adapted for reproduction in the form of written essays, and these make exceptionally pleasant reading.

While dealing with a variety of subjects, the lectures concern themselves mainly with problems of medical education, and with biological problems raised by the consideration of the relation between structure and function. Biologists who have devised theories to explain the structural organization of living creatures have usually appreciated the difficulty of linking structure and function in a common theory of causation. These contrasting aspects of biological study have in the past, indeed, led to an artificial separation of the two scientific disciplines anatomy and physiology, and this again has inevitably encouraged a somewhat dualistic conception of living organisms. Prof. Wood Jones is intent upon the destruction of such an illusion, and would re-orientate the teaching of anatomy so as to stress the fact that structure is only the ultimate expression of function.

Prof. Wood Jones's own views are frankly Lamarckian. For him the precision and consistency with which structures, developed in embryonic life, are adapted for their ultimate function are not intelligible unless the inheritance of acquired characteristics is postulated. Yet even he finds remarkable instances of a disharmony between structure and function. The formation of a median vagina in marsupials, according to his interpretation, was a last-minute effort on the part of Nature to avert a catastrophe which was nearly brought about in metatherian evolution by the fact that the initial vaginal canals were too small to allow parturition to occur. He conceives, also, that by some sort of morphological accident the vertebrate eye during early phylogenetic development became caught up with the infolding medullary tube and inadvertently buried. By good fortune, however, it managed to "struggle" towards the surface again, but only at the expense of becoming inverted, and therefore less perfect as a piece of apparatus than it might have been.

Such instances are here quoted to illustrate the fertility of the author's mind, a fertility which expresses itself in many original ideas and novel interpretations. We cannot but feel that all biologists and many other scientific workers will derive very considerable pleasure and intellectual exercise from reading these lectures.

SCIENCE AND PRACTICE OF FODDER CONSERVATION

The Science and Practice of Conservation Grass and Forage Crops. By Dr. S. J. Watson. In 2 vols. Vol. 1. Pp. xi + 415. Vol. 2. Pp. vii + 417–820. (London: *Fertiliser and Feeding Stuffs Journal*, 1939.) 2 vols., 30*s*.

FARM animals are wintered on fodder and root crops, supplemented by concentrates, that is, grain, milling offals, oil-seed residues, etc.; the fodder, roots, and frequently the grain also are home grown. The preservation of the fodder crops, for use in the winter, presents more difficulties than that of the other home-grown foods, and the quality of the product is very variable, depending on the kind of crop, its stage of maturity when cut, etc. The quality of the product is important, because it governs the amount and kind of concentrates that have to be purchased.

Two recent developments, the improvements in the technique of making silage, and the application of artificial drying to grass and other fodder crops, have aroused much interest among farmers and research workers in fodder conservation, since they have resulted in widening the range of crops for preservation, and also in making it possible to preserve them at a younger stage; these developments have brought within reach of the farmer fodders of higher nutritive value, and with a greater proportion of proteins.

On the Continent of Europe, the new and improved methods of making silage have resulted in the preservation, for use in winter, of large areas of clover, or of grass and clover mixtures, while in Great Britain interest has been aroused in the conservation of young pasture grass by artificial drying, and by ensiling. Young grass contains up to 20 per cent, or more, of crude protein in the dry matter, and its conservation would dispense with the need for purchasing most of the concentrated foods now fed to cattle, sheep and horses.

It can be readily understood how important this possibility is in a country like Great Britain, which is so suited by climatic and other conditions for producing grass Even in the United States, where there are such ample supplies of grain and of some oil-seed residues, much interest is shown in the possibility of reducing the requirements of concentrates by improvements in the quality of fodders.

Dr. S. J. Watson, in "The Science and Practice of Conservation", has brought together, from all parts of the world, the results of research and practical experience in fodder conservation, and the two volumes present an excellent account of the state of knowledge on all aspects of the subject. The first volume deals with the various processes of conservation, natural drying, artificial drying, and ensilage; separate chapters are devoted to the losses of nutrients in each of these processes. The author directs attention to the heavy rate of losses in haymaking, pointing out that the losses are really heavier than are commonly supposed because of the failure to realize that the actual loss of feeding value exceeds that of the dry matter, since the material lost is the most digestible part.

Silage-making occupies a large share of the volume. Before discussing the old and the new methods, the author deals fully with the principles underlying the making of silage. Although the crops for ensiling and the climatic conditions vary from one country to another, the fundamental requirements of successful silage-making are the same, and this volume gives the research worker the type of information that will help him to solve the problems involved in directing the chemical and biological changes in the material in the desired direction.

The second volume deals with the nutritive values of the various conservation products, and contains accounts of the numerous feeding trials reported in the literature. One chapter is devoted to the effects of conservation products on dairy produce, a subject of great importance in peace time in those countries exporting cheese and butter. The last chapter is devoted to the place of conservation in agricultural practice at home and abroad, and deals also with its effect in cheapening the costs of foods for human consumption, and in improving their quality with regard to the health of the nation.

Dr. Watson, by reason of the large amount of research that he has carried out on this subject at Jealotts' Hill, and of his contacts with the practical aspects of the problems, is well qualified to undertake the writing of such a work. Both volumes are of great value to all those interested in fodder conservation, and can be particularly recommended to those engaged in research investigations touching any aspects of this subject.

E. J. ROBERTS.

THE BRITISH EMPIRE CANCER CAMPAIGN

BY DR. E. BOYLAND,
THE ROYAL CANCER HOSPITAL, LONDON

THE publication of the sixteenth annual report of the British Empire Cancer Campaign was very little delayed by the outbreak of hostilities, and the report has appeared in its usual form and is actually larger than it has ever been before. During the War as much cancer research as possible will continue, so long as the scientific workers concerned are not all required for emergency work. There is no doubt that the greatest progress in cancer research has been made in Great Britain and in the United States. Government support and large endowments in the United States are likely to increase American cancer research in the future, and it is to be hoped that the British effort will not fall off.

Among the clinical accounts in this report is a description by Mr. J. P. Lockhart-Mummery and Dr. C. E. Dukes of the familial adenomatosis of the colon and rectum and its relationship to cancer. Adenomatosis is an inherited disease, which is not generally manifested until childhood or puberty. The malignant disease which frequently develops from this adenomatosis occurs at a relatively early age and often has multiple foci of carcinoma. The adenomatosis appears to be transmitted by both sexes, probably as a Mendelian character.

Much of the clinical work describes the results of radiological treatment. Such material is given in the reports of the Westminster Hospital, St. Bartholomew's Hospital, the Marie Curie Hospital and the Mount Vernon Hospital. One interesting development of research on radiations is the discovery of the rhythmic or periodic variation in their action on colloids. If colloidal solutions of carbon, graphite, quartz, gold or albumin are irradiated with a certain dose of neutrons, X-rays, γ-rays or by ultra-violet light, they are coagulated, but if the dose is increased by a certain amount no coagulation occurs. With increasing amounts of radiation, the effect on coagulation alternately increases to a maximum and then falls to zero. This appears to be a periodic phenomenon analogous to the formation of Liesegang rings, and it would be extremely interesting to know if the same periodic variation occurs in the irradiation of living tissues.

At the recently formed Cancer Research Centre of the University of Oxford, Dr. I. Berenblum, Dr. E. Chain and Dr. N. G. Heatley have investigated the metabolic activities of very small amounts of surviving skin epithelium in a micro-respirometer. This tissue shows aerobic glycolysis and has a respiratory quotient of 0·7, properties which at one time were considered to be peculiar to tumour tissues. In fact, the current report from the Royal Victoria Infirmary, Newcastle-on-Tyne, contains the following rather misleading statement. "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. First the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal." Since Warburg discovered that slices of malignant tissues produced lactic acid from glucose in the presence of oxygen, retina, smooth muscle, striped muscle, liver, cartilage, bone marrow, lymph glands, kidney medulla and skin have also been shown to glycolyse aerobically. It is therefore impossible to consider this characteristic to be peculiar to tumours. Neither is the lowered respiratory quotient specifically characteristic of malignant tissues.

It was known that the magnitude of respiration and glycolysis did not vary greatly in tumours of different rates of growth, and now Dr. E. Boyland and Mrs. M. E. Boyland have shown that this holds even with enormous variations in growth-rate and that it is possible to inhibit the growth of sarcomata in mice without significantly reducing the respiration and glycolysis as measured *in vitro*. Thus the largest metabolic processes do not vary with rate of growth; this suggests that some tumours must be extremely inefficient in obtaining energy for growth from carbohydrate.

Experiments on carcinogenesis are described in several of the reports. At St. Bartholomew's Hospital, 1 : 2 : 5 : 6-dibenzanthracene in olive oil was introduced into the stomachs of mice in an attempt to produce cancer of the alimentary tract. No alimentary tumours were produced but 95 per cent of those mice which survived the period of injection died with pulmonary tumours. Only minute amounts of the carcinogenic compound could have reached the lungs, and the experiment indicates that the lungs are very sensitive to the tumour-inducing action of dibenzanthracene and that the tissues of the alimentary canal are very resistant.

Other experiments showing the amounts of carcinogenic agent necessary for tumour production were carried out by Dr. P. M. H. Browning at

Glasgow. In these the injection of 0·0025 gm. of 2(*p*-amino-styryl) 6(*p*-acetylamino benzoylamino) quinoline methoacetate ('Styryl 430') into mice was necessary to produce sarcomata, while even with 0·0005 gm. a small coloured depot may be found more than a year after injection. Many other trypanocidal compounds related to Styryl 430 have been tested, but as yet this is the only known compound of its type with carcinogenic activity.

Mr. J. C. Mottram, at the Mount Vernon Hospital, has used the sensitivity of Infusoria to demonstrate the photo-oxidation of carcinogenic compounds. On the whole, the carcinogenic compounds are easily oxidized in ultra-violet light to water-soluble toxic products, and there is rough but not exact parallelism between this action and carcinogenic power. Similar results were obtained some years ago by Dr. E. Boyland, who examined the effect of photo-oxidation products on the enzyme lactic dehydrogenase. The chemical changes which carcinogens undergo in ultra-violet light in the presence of oxygen are still obscure, but Prof. J. W. Cook and Mr. R. Martin of the Royal Cancer Hospital have isolated the photo-oxide of 9 : 10-dimethyl-1 : 2-benzanthracene. The parent hydrocarbon, 9 : 10-dimethyl-1 : 2-benzanthracene, has very high carcinogenic activity, producing epithelial tumours in mice in thirty-five days; 5 : 9 : 10-trimethyl-1 : 2-benzanthracene, however, is now the most active compound and has given skin tumours in thirty-one days in tests carried out at the Royal Cancer Hospital. Derivatives of 1 : 2-benzanthracene with substituents in the 9 and 10 (meso) positions not only give more stable photo-oxides but also more stable maleic anhydride derivatives; thus Dr. L. D. Parsons and Mr. F. L. Warren find that the α-β-endosuccinate of 9 : 10-dimethyl-1 : 2-benzanthracene is very stable and is not carcinogenic, while the corresponding derivative of methylcholanthrene dissociates and is actively carcinogenic. These results indicate that the action of these water-soluble carcinogenic compounds is due to their ability to dissociate and liberate the parent hydrocarbon after injection rather than to the action of the water-soluble compound *per se.* These water-soluble carcinogenic compounds cause lysis of red blood cells *in vitro*, but this action is also shown by similar derivatives of some compounds which have no carcinogenic action.

Dr. P. A. Gorer at the Lister Institute has investigated immunity within pure lines of inbred mice. While it is relatively easy to produce immunity to a tumour in mixed stock animals it is extremely difficult to demonstrate immunity within a pure line. With two types of leukæmia which have been maintained in the pure lines in which they arose, it has not been possible to produce immunity within the homologous pure strain. The response of grafted embryonic tissue is similar to that of neoplastic tissues and different from that of placental tissue, which will not grow even in mice of the homologous pure line; but in general the defence reactions to implanted tissue are governed by genetically determined antigenic differences between the implanted tissue and the host. Experiments on resistance to the Jensen rat sarcoma carried out at the Middlesex Hospital by Prof. S. Russ and Dr. G. M. Scott have shown that the immunity induced by treatment of tumour-bearing rats with X-rays is inherited by the offspring. This appears to be an example of inheritance of an induced or acquired character.

By far the largest individual account in this year's report is that from Dr. P. Stocks, of the General Register Office, Somerset House, on the distribution of cancer of various organs in England and Wales. This account, which is the third and concluding instalment, deals with the cancer mortality of the female population and is more of the nature of a scientific paper than an interim report of work in progress. The standardized mortality ratios for separate towns and counties have now been computed and the results are given in a series of tables and maps. As would be expected from analogous investigations, the mortality from cancer of all sites varies much less than the mortality due to cancer of particular sites. Thus the cancer mortality of part of Wales (Anglesey, Carnarvon, Denbigh, Flint and Merioneth) and of Lincolnshire is higher than that of the rest of the country; but the excess mortality is only of the order of 15 per cent. The high cancer mortality of North Wales is entirely accounted for by an excess of stomach cancer, affecting both sexes. Dr. Stocks suggests that this excess, which is about one and a half times the expected mortality, is due to dietary factors. It is hinted that the bulk of the North Wales population does not consume sufficient vegetables and fruit, and uses the frying-pan too frequently. If this mortality from gastric cancer could be reduced, people escaping might contract cancer at some other site, which might be more amenable to treatment, and some of them would probably avoid cancer altogether.

In the results are several examples of low mortality from cancer of one particular site being compensated for by excessive incidence at some other site. Thus there is a high incidence of uterine cancer in the north-east of England, and in this area cancer of the breast is correspondingly low. Analogous differences are found in the social classes. The incidence of cancer of the uterus in married women decreases steadily with rise in social class, while cancer of the breast is more frequent in the upper classes. This may be connected with birth-rate, as fertility varies inversely with income. Also it is known that countries with high birth-rates tend to have higher relative proportions of uterine and lower proportions of breast cancer; cancer of the mouth, pharynx, œsophagus, skin and vagina, like uterine cancer, are more common in the lower classes, while cancer of the ovary and thyroid, like breast cancer, are more common in the upper classes.

For almost all sites of cancer that are examined (except cancer of the ovaries) the urban incidence is higher than that in rural districts. The figures for cancer of the lung in different districts are difficult to explain; the incidence being very high in Manchester, Leeds, Sheffield and Birmingham, but low in other towns in Lancashire, Durham and Stoke-on-Trent.

The results of Dr. Stocks's investigations have been dealt with at some length partly because it is conceivable that men of science who are not specially working at the cancer problem might see some explanation of the regional distribution of cancer mortality. Such explanations might give rise to fruitful research on the cause of the disease at a particular site.

Until the outbreak of war, British cancer research had been increasing in its extent and effectiveness, as is clearly shown by the annual reports of the British Empire Cancer Campaign. Let us hope that the work will continue and that the present position will be consolidated and extended in the immediate future.

MACROMOLECULES

SOME developments in the chemistry and physics of macromolecules were discussed at a recent meeting of the Plastics Group of the Society of Chemical Industry and the Faraday Society. Many fundamental problems were raised in the papers contributed by Dr. R. Bhattacharya, E. G. Couzens and H. W. Melville, and in the subsequent discussion; only a few can be referred to in the present article.

In the synthesis of macromolecules from vinyl derivatives of the general type $CH_2 = CXY$, much controversy has arisen about the nature of the active polymer molecules which react with the monomer. Two extreme types may be recognized. The monomer may be converted by absorption of energy to a diradical. To each end of this molecule monomeric molecules may add on, giving rise to a bigger diradical. This may be called the free radical mechanism. On the other hand, the monomer may merely be excited to an extent such that the addition of monomer is facilitated. In this mechanism there is always a terminal double bond in the macromolecule which is the centre of reactivity. It would now appear that it is possible to polymerize one and the same molecule by either mechanism, depending on conditions.

The difficulty really arises in discovering in any one instance which particular mechanism comes into operation. In gas phase polymerization it is often possible to settle the matter in the following way. Hydrogen atoms or methyl radicals add on readily to vinyl derivatives, such as vinyl acetate, producing a single free radical with which monomer easily reacts to form a linear polymer until two such radicals combine. By altering various parameters, it is then easy to characterize this free radical growth and compare it with the polymerization under observation. If the kinetics are identical, it must be supposed that the latter reaction is of the free radical type. In the photo-polymerization of gaseous vinyl acetate, the kinetics are so different from those of the free radical reaction that it would seem the ordinary polymerization occurs by some double-bond mechanism. The difficulty yet to be solved is how the terminal double bond of the active molecule retains its activity. It is well known that a large number of these molecules, including vinyl acetate, also polymerize in the liquid phase, but so far no similar attempt has been made to discover by what mechanism the molecules grow, though it is of interest to mention that a free radical polymerization has been induced in styrene by the addition of tetraphenylsuccinodinitrile, which dissociates to free radicals in solution.

From the photochemical point of view, vinyl ketones are of especial interest. Both methyl vinyl ketone ($CH_2 = CH.CO.CH_3$) and methyl isopropenyl ketone ($CH_2 = C(CH_3).CO.CH_3$) polymerize on illumination with light at 3000 A., though the former molecule does so much more readily than the latter. Once more this is in accord with the general observation that α-methyl substituted vinyl derivatives are more difficult to polymerize than the parent molecule. Methyl vinyl ketone exhibits rather peculiar behaviour. Like most gaseous ketones, it is decomposed by light, and therefore in considering the mechanism of polymerization, it is not impossible that, besides the two mechanisms mentioned above, another must be taken into account. The primary products of decomposition may well be free radicals, in which circumstance they may start off a free radical polymerization. Here a comparison of the kinetics of the methyl radical sensitized reaction with the direct reaction shows that the latter reaction does in fact take place by the free radical mechanism, initially started by the photo-decomposition of the methyl vinyl ketone molecule. The product of the reaction is, however, insoluble in all solvents, which points to the fact that the molecule is extensively cross-linked. This is reflected too in the abnormal kinetics of the reaction, in that at high enough pressures the order may be as much as five and the negative energy of activation is a function of temperature, whereas in any ordinary photo-reaction the order is rarely greater than two and the rate may only vary exponentially with temperature. Such kinetics can only be explained by postulating branching of the growing molecules—by what precise mechanism is not known. This is the first simple molecule to be studied in which so-called kinetic as well as structural branching have been observed simultaneously.

This introduces the problem of correlating the properties of macromolecular substances with their structure and mode of synthesis. Even correlation of structure and properties is difficult with natural and synthetic polymers. Probably the two most important groups of molecules to be considered in this respect are (*a*) cellulose and its derivatives, and (*b*) vinyl polymers. In neither case is it possible to account quantitatively for the relatively poor mechanical properties, such as tensile strength and modulus of elasticity, as compared with the values calculated theoretically on the assumption that these properties are wholly dependent on the nature of the primary valencies existing in those macromolecules. This is to be expected to some extent, because in any test it is impossible to determine the properties of an adlineated bundle of molecules in view of the small size of even the largest of such linear molecules. The forces which determine these physical properties must therefore consist largely of an intermolecular variety the magnitude of which is exceedingly difficult to compute.

Matters are much more complicated when an attempt is made to define accurately terms such as toughness, and to correlate this with molecular architecture. Practical experience soon singles out those polymers which are generally recognized as tough, with the result that the consensus of opinion appears to be that toughness is a complicated function of impact resistance, tensile strength, extensibility, Young's modulus and bending strength. Some of these properties are in themselves difficult to determine by unequivocal methods. None the less, it is practicable to gain a qualitative idea of the type of molecule most suitable for any given purpose. Such studies will no doubt eventually provide the material for putting the subject on a more scientific basis. But a useful working criterion appears to be given by the total area under the so-called Schopper curve. This is a curve obtained by plotting the load on a material as a function of the percentage elongation. With those plastics normally regarded as tough, for example, cellulose nitrate and acetate, ethyl cellulose suitably plasticized, the curve rises rapidly and then flattens out over a considerable elongation. The triacetate and nitrocellulose are particularly good in this respect. For the exhibition of high extensibility, however, all these molecules must be plasticized, but experiments with other cellulose have shown that a plasticizer is not really necessary if, say, ethyl groups replace the hydrogen atoms of the hydroxyl groups. Unfortunately, the tensile strength of ethyl cellulose is inferior to that of nitrocellulose. Vinyl compounds, on the other hand, do not show this high extensibility, although vinyl chloride is regarded as being very tough. The great extensibility of the cellulose derivatives can be simulated if appropriate side chains are added to the molecule as in polyvinyl butal, but at the expense of a decrease in tensile strength. The addition of plasticizers does not improve matters, as with cellulose, for then the material loses its resistance to deformation and becomes rubber-like in character.

Progress in this field is greatly hampered by the fact that the molecular weights and molecular size distribution are not known for the majority of these polymers. The viscosity method of Staudinger is the only one which is used extensively for large linear molecules, but the discrepancies brought to light when the results obtained with this method are compared with those from end-group determination and by osmotic methods show that all is not well. In view of these difficulties, attempts have been made to modify the simple Staudinger relationship that the specific viscosity of the solution is proportional to the molecular weight of the dispersed phase, but with only limited success. A striking example of the enormous influence of the solvent is shown by the fact that a twenty per cent solution of cellulose in acetone is easily pourable, whereas a similar solution in dimethyl phthalate forms a stiff gel. Part of the trouble would seem to lie in the sensitiveness of specific viscosity to the distribution of molecular sizes in the polymer. Moreover, it is just this factor which is so important in influencing the physical properties mentioned above. It seems to be a general rule, however, that properties such as tensile strength and Young's modulus increase to a rough maximum with increase in molecular weight. The absolute value of these quantities depends on the nature of the side groups. Those groups exhibiting relatively small interactions, such as phenyl, lead to weakness, while hydroxyl, formal, acetal groups and chlorine atoms yield stronger polymers even although the length of the carbon chain is identical in both cases.

All this work has had its effect on improving natural resins by systematic methods. Shellac may be cited as a typical example. It consists of a saturated pentahydroxy monobasic acid of partially known constitution and molecular weight of about 1,000. As such the substance is of no use as a plastic, but it may be modified to give a great variety of useful products. On heating, it may be polymerized to linear molecules of much higher molecular weight. That this is due to interaction between hydroxyl groups and carboxyl groups of different molecules is shown by the fact that, if either of these groups is chemically bound to other small molecules, such as by the formation of ethers or esters, this polymerization will not take place. By further heat treatment the shellac may be made insoluble, owing presumably to the cross linking which can occur by means of the multiplicity of hydroxyl groups in the 'monomer'. If, however, these hydroxyl groups are modified by reaction with ethylene glycol, this reactivity is cut down to such a point that cross linking is impeded. The result is that much longer linear molecules may be formed with molecular weights up to 25,000. The polymerized lac is then a tough flexible rubber-like substance. Interpolymerization of shellac with naturally occurring unsaturated resins gives rise to a product similar to drying oils used in paints. Further, such composite molecules may be induced to react with formaldehyde to give complex cross-linked molecules of desirable film-forming properties.

CARBON DIOXIDE IN ARCTIC AND ANTARCTIC SEAS

By Dr. G. E. R. Deacon,
"Discovery" Investigations

FOR many years past, Prof. K. Buch of the Åbo Akademi, Finland, has been leading the research on the distribution of carbon dioxide in the sea and its interchange between sea and atmosphere, and lately by a survey of the surface waters of the North Atlantic Ocean[1] he gives a very clear demonstration of the value of his methods.

Less than one per cent of the carbon dioxide in the sea is in ordinary physical solution, the greater part being there as carbonate and bicarbonate ions. First there is an equilibrium between dissolved gas and $H^{\cdot}$ and HCO_3' ions, and then between HCO_3', $H^{\cdot}$ and CO_3'' ions, both reactions being influenced by temperature and pressure, and by the concentration of the other ions present, particularly $Ca^{\cdot\cdot}$, $Na^{\cdot}$, $Mg^{\cdot\cdot}$ and SO_4''. The behaviour of sea water towards carbon dioxide is therefore very different from that of fresh water: it acts as a buffer solution, and a comparatively large volume of carbon dioxide can be absorbed or given up at the surface without much change in the concentration or partial pressure of the part of the gas that is in physical solution.

Buch and his collaborators had already reached the important conclusion that the equilibrium between dissolved and combined carbon dioxide is fully determined by hydrogen ion concentration, temperature, pressure and alkalinity (as measured by titration)[2]: if these are known, the partial pressure of dissolved carbon dioxide and the concentrations of HCO_3' and CO_3'' ions can be calculated; and since Wattenberg has shown that alkalinity is in general proportional to chlorine content[3], it is sufficient to know temperature, pressure, hydrogen ion concentration and chlorine content.

Buch's recent observations cover practically the whole of the North Atlantic, from Denmark and New York as far as the Arctic pack-ice; but they were all made during the summer months. His calculations based on *p*H measurements, amply confirmed by direct analyses, revealed the remarkable fact that the carbon dioxide content of the surface water (free plus combined carbon dioxide), in any part of the extensive region examined, bore a constant relation to alkalinity, and therefore to chlorine content and salinity: expressing the total carbon dioxide of any sample in millimols per litre, he found the expression $\Sigma CO_2 = 0{\cdot}108\ Cl^{0}/_{00} \pm 1{\cdot}5^{0}/_{0}$.

This means that the total concentration of carbon dioxide in the surface water was controlled within very narrow limits until it had a certain relation to the power of the water for combining chemically with carbon dioxide.

Biological activity and vertical mixing with the deeper water will have an effect on this relation;

a diatom outburst will lower the carbon dioxide content, while the upwelling of deeper water or a rich zooplankton will cause an increase. The fact that Prof. Buch's observations were all made during the summer months must therefore be emphasized; and attention given to his reasoning that in winter, when the phytoplankton activity is very small and vertical mixing greatly increased, the carbon dioxide may bear a higher ratio to chlorine.

Type of Surface Water	SUMMER Nov. 23–March 18, 1938–39					WINTER July 2–Sept. 26, 1938				
	Number of observations	ΣCO_2 m.mol/l.	ΣCO_2 Cl‰	pCO_2 10^{-4}atm.	O_2 % sat'tn.	Number of observations	ΣCO_2 m.mol/l.	ΣCO_2 Cl‰	pCO_2 10^{-4}atm.	O_2 % sat'tn
Subtropical (south of 35° S.)	13 11·8° C. to 21·5° C.	2·04 1·99–2·09	0·104 ±3%	2·8 2·4–3·8	96 93–100	11 11·4° C. to 18·6° C.	2·08 2·05–2·11	0·107 ±2%	3·2 3·1–3·5	92 89–95
Sub-Antarctic	22 3·7° C. to 17·6° C.	2·06 2·02–2·09	0·108 ±3%	3·0 2·6–3·5	98 94–99	17 3·9° C. to 12·4° C.	2·09 2·07–2·12	0·110 ±2%	3·3 2·9–3·5	94 92–95
Antarctic (north of 57° S.)	17 −1·8° C. to 2·9° C.	2·10 2·08–2·13	0·112 ±1%	2·9 2·3–3·6	95 90–99	18 −1·8° C. to 2·0° C.	2·14 2·11–2·17	0·114 ±1%	3·3 3·1–3·6	91 85–94
Antarctic (south of 57° S.)	23 −1·4° C. to 1·3° C.	2·10 2·06–2·13	0·112 ±1%	2·6 2·3–3·6	95 90–102					

This is proved in the Southern Ocean by repeated observations made by the R.R.S. *Discovery II*[4] in the sector between 0° and 20° E., summarized in the accompanying table. In some contrast to the conditions in the North Atlantic, it was found that the $\Sigma CO_2/Cl$ ratio increased from low to high latitudes, and subtropical, sub-antarctic and antarctic waters were found to have their own typical ratios. Extreme values in each zone were found to overlap with those of the next; but there was sufficient grouping about the mean values to give them significance, and the existence of such typical values for each zone is not unlikely because biological activity and vertical mixing depend on sunshine, concentration of nutrient salts, stability of the upper part of the water column, and strength and variability of wind, all of which are to some extent determined by latitude and by the hydrographical conditions typical of the zones. In the part of the subtropical zone that was examined, and in the sub-antarctic zone, the variations of the extreme values about the means were greater than Buch's figure of 1·5 per cent for the North Atlantic, but the upper part of the water column is less stable.

Prof. Buch's papers contain much more information. Although the salinity of the water in a particular region will fix the total carbon dioxide content, the proportion of dissolved to total carbon dioxide will vary with temperature, and the partial pressure of the dissolved gas (the pressure of carbon dioxide in an atmosphere in equilibrium with the water) must show a still greater variation because it depends on the solvent power of the water, which is greater at low temperatures.

Near the Arctic pack-ice Buch found (as the ratio $\Sigma CO_2 = 0{\cdot}108 Cl°/_{00}$ demands) partial pressures of carbon dioxide in the surface water as low as $1{\cdot}6 \times 10^{-4}$ atmosphere—about half the pressure which is needed to satisfy the same relation for total carbon dioxide in the warmer and more saline waters of the temperate region. The partial pressure of carbon dioxide in the air above the ice-edge was 3×10^{-4} atmosphere; but the wind was blowing southwards off the ice and had not reached an equilibrium with the water; by the time it had passed over some 100–200 miles of the open sea, its partial pressure of carbon dioxide was reduced to $1{\cdot}6 \times 10^{-4}$ atm.—as low as that of the water. The air in the polar region—derived from upper-air currents which have their origin in temperate regions—has apparently a normal carbon dioxide content, but in summer at least it is greatly modified during its passage across the fertile Arctic fringe, and even as far south as Iceland and Petsamo, 'Arctic air' can be distinguished from winds of temperate and continental origin by its low carbon dioxide content.

In the Antarctic sector between 0° and 20° E. the partial pressure of carbon dioxide was not found to fall as low as Buch's Arctic values; but although the figures in the accompanying table appear to be typical of the greater part of the Antarctic Ocean, the conditions in the more sheltered localities are very like those of the Arctic. In such places the $\Sigma CO_2/Cl$ ratio becomes reduced below any value shown in the table, and, for example, in the Bay of Whales in the Ross Barrier, off the west coast of Graham Land, at the edge of the pack-ice after exceptionally long spells of fine weather, and near South Georgia at a time of exceptional phytoplankton activity, the partial pressure of carbon dioxide in the surface water has been found to be as low as $1{\cdot}6 \times 10^{-4}$ atm.—the same as at the Arctic pack-ice.

The only determinations of atmospheric carbon dioxide in the Antarctic appear to be those quoted by Buch[5], from the results of one of Charcot's expeditions to the west coast of Graham Land: ten samples ranged from $1{\cdot}45 \times 10^{-4}$ atm. to $2{\cdot}55 \times 10^{-4}$ atm., with an average of $2{\cdot}26 \times 10^{-4}$ atm.

The *Discovery II* observations show that the low carbon dioxide pressures are likely to be found only in the summer months: in winter the $\Sigma CO_2/Cl$ ratios were so high that even the freezing water had carbon dioxide partial pressures of at least $3{\cdot}1 \times 10^{-4}$ atm.

It has not been possible in this short article to do justice to the earlier workers on the carbon dioxide problem, notably Prof. A. Krogh and J. F. McClendon, or to describe recent work in the Barents Sea and the Baltic, and more particularly Prof. Wattenberg's treatment of the *Meteor* observations, but enough has been said to show what great opportunities the accurate measurement of hydrogen ion concentration in the sea offers.

It may, for example, be worth while to review what has been done on the relations between animal behaviour and alkalinity in the sea, because carbon dioxide concentration may be as effective in governing shoaling and distribution as hydrogen ion concentration; there are also many outstanding problems relating to the decomposition of plankton that can be re-examined by calculating carbon dioxide concentration from hydrogen ion concentration measurements; the Discovery Committee's data will help to solve some of them.

Carbon dioxide determinations have also geophysical and climatological interest. Since the ocean has such a tremendous capacity for carbon dioxide, it must, practically speaking, control the carbon dioxide content of the atmosphere, and where equilibrium with the surface water is established the atmospheric carbon dioxide pressure will depend to some extent on biological activity and distribution of nutrient salts; the low carbon dioxide pressures around the polar fringes in summer give these regions an added attraction. Continental air has generally a high carbon dioxide content; but Prof. Buch shows that modern development can have very little influence on the total carbon dioxide content of the atmosphere, and his figures are refreshing, as his papers are.

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[1] Buch, K., "Beobachtungen über chemische Faktoren in der Nordsee, zwischen Nordsee und Island sowie auf dem Schelfgebiete nördlich von Island", Conseil perm. intern. pour l'exploration de la mer. *Rapp. et proc. verbaux*, **89**, III, 13–31 (1934); "Beobachtungen über das Kohlensäuregleichgewicht zwischen Atmosphäre und Meer im Nordatlantischen Ozean", *Acta Acad. Aboensis, Math. et Phys.*, **11**, 9, Åbo, Finland (1939); "Kohlensäure in Atmosphäre und Meer an der Grenze zum Arktikum", *Acta Acad. Aboensis, Math. et Phys.*, **11**, 12, Åbo, Finland (1939).

[2] Buch, K., Harvey, W. H., Wattenberg, H., and Gripenberg, S., "Über das Kohlensäuresystem im Meerwasser", Conseil perm. intern. pour l'exploration de la mer. *Rapp. et proc. verbaux*, **79** (1932); "On Boric Acid in the Sea and its Influence on the Carbonic Acid Equilibrium", Conseil perm., etc. *Rapp. et proc. verbaux*, **85** (1933).

[3] Wattenberg, H., "Kalziumkarbonat und Kohlensäuregehalt des Meerwassers", Wissenchaftliche Ergebnisse der Deutschen Atlantischen Expedition, 1925–27, **8** (1933).

[4] NATURE, **143**, 1033 (1939).

[5] Buch gives the reference: Lundegårdh, Henrik, "Der Kreislauf der Kohlensäure in der Natur", Jena, pp. 37–38 (1924).

OBITUARIES

Sir Gilbert T. Morgan, O.B.E., F.R.S.

SIR GILBERT MORGAN died after a very short illness on February 2 in his seventieth year. For fifty years he had been engaged in chemical research and probably no other chemist had such wide knowledge of scientific and applied chemistry. A fitting mark of the Jubilee was the presentation to him in July last of the medal of the Society of Chemical Industry, its highest honour; on this occasion he gave an account of his career and an outline of his researches.

A professor to-day has the advantages of laboratories and equipment such as were never dreamed of by his forebears; he is more dependent than they were on his research students and collaborators. Morgan was happy in this respect; he gave full credit, developed the personal side and received the most loyal support. This in part accounts for the great volume of work accomplished.

Handsome, with alert and friendly eye, yet quiet in manner, Morgan had an amiable personality. He was wedded to chemistry, and when not at the laboratory bench or directing research he was to be found working for one or other of the chemical societies. In their more sociable gatherings he had the gracious assistance of Lady Morgan, *née* Kathleen Desborough.

Morgan was a student of Meldola at Finsbury and came under the practical teaching of Streatfield, who has influenced so many chemists. Meldola was then working on dye stuffs and consulting for Read Holliday at Huddersfield, who found a post for Morgan at the end of his college career.

Here a wide field was open for research, and among other tasks, Morgan prepared the ten dihydroxynaphthalenes, which took him four years. He relates that he condensed formaldehyde with phenol to a product which solidified to a clear amber resin. As the material had no value for making colours it was set aside. This was in 1893, and it was not until 1906 that Bakeland patented the process as a synthetic resin and made a large fortune out of it.

In 1894 Morgan became restless in industry and went back to college, graduating at the Royal College of Science under Sir William Tilden and being appointed to the staff there. In 1904 he began the fruitful co-operation with Miss Micklethwait leading to work on organic derivatives of phosphorus, arsenic and antimony.

Morgan passed on to the Royal College of Science, Dublin, where he was at the outbreak of the War of 1914–18. In 1915 he went back to his old firm, now British Dyes, for a short period to help reconstruct the industry. But in 1916 he returned to academic life and to Finsbury to succeed Meldola, transferring to Birmingham as Mason professor in 1919. In 1925 came what he described as "a State experiment in Chemical Research", namely the decision to form a Government Research Laboratory at Teddington under the Department of Scientific and Industrial Research, with Morgan as its first director.

It was generally felt that no one was better fitted for the task, but opinions were sharply divided as to the nature of the work which could best be carried out there. It is widely accepted now that Morgan made a success of the task, and that when he retired after thirteen years he left the Chemical Research Laboratory as an asset of real value to the nation. The work done by the Laboratory during the first few months of the War has fully justified all the hopes which Morgan had for its future, and it was a keen pleasure to him to hand over the directorship to one of his students, Dr. G. S. Whitby.

Morgan organized a variety of work at Teddington, including an installation for high-pressure reactions, a branch of chemistry then in its infancy. His interest in chemical engineering had always been strong, and he did much to develop the autoclave.

Morgan's scientific researches cover so wide a field that any reference to them in detail here is impossible for lack of space. Their very diversity prevented perhaps the highest achievement in any one field, though all were fruitful to a greater or less extent. Morgan's claim to fame rests on broader foundations. He did as much as anyone to place the science of chemistry on a sure basis in Britain. By teaching and research, by co-operation with industry, he inspired men to succeed in solving chemical problems and advanced the national status and prestige in chemistry, pure and applied.

At a moment when most men would have sought ease, he was ready to start again in a new branch of his subject as chairman of the Research Fund Committee, Institute of Brewing. He received numerous honours, a knighthood in 1936, honorary degrees at Dublin, Birmingham, St. Andrews, the fellowship of the City and Guilds Institute, to mention only a few. He was formerly president of the Chemical Society and of the Society of Chemical Industry, and an indefatigable worker on committees.

We have lost his kindly presence and the help of his clear incisive mind all too soon. A life crowded with change and incident may have caused him to live faster than some of us; we could have wished for his ripe counsel in old age.

E. F. Armstrong.

Mr. E. S. Harkness

Mr. Edward Stephen Harkness, the American philanthropist, who died on January 30 just a week after his sixty-sixth birthday, devoted his last score of years to administering and sustaining the benefactions instituted by his mother, who founded the Commonwealth Fund in America in 1918. The Harkness fortune was made in Standard oil. It dates from about seventy years ago, at which time Stephen V. Harkness, the father, who was in a small way of business in Cleveland, Ohio, is said to have lent the daring young Rockefeller £1,200. In the present century the example set by Rockefeller in efficient philanthropy inspired the Harkness family. After the death of the father, mother and son made philanthropy their first interest. The elder Mrs. Harkness died in 1926, leaving for the Fund an endowment of about £7,500,000, which sum Edward Harkness later increased to more than £10,000,000. But he also bestowed large personal gifts.

Efforts of the Commonwealth Fund have taken chiefly the lines of education and of public health. In England the first major gift was the fellowships for post-graduate Britons in American universities, the counterpart to the Rhodes scholarships, except that Commonwealth fellows may proceed to any of about twelve universities in America, either between the Atlantic coast and the Mississippi, or on the Pacific coast. The stipend is £600 a year for two or three years; to date appropriations for these fellowships have reached a total of £650,000. Most of the holders have studied science in America—physics, chemistry, biology, engineering. In 1930 Harkness gave to England the Pilgrim Trust, £2,000,000, the first grant from which was given to the building fund of the Royal Institution. The five original trustees of the Pilgrim Trust still serve. A third Harkness philanthropy in Great Britain was the Child Guidance Council, a centre of information upon 'mental health' for children. Recently in Woburn House, the Council is now evacuated to Bath, and is itself at present engaged in an inquiry into "emotional and behaviour problems" of evacuees.

Grants from the Commonwealth Fund in America have taken a general medical turn, following in that subject the pattern of the Rockefeller Foundation, and contributing in the past twenty years about £4,000,000. Part of this sum has subsidized research in trachoma, leukæmia, functions of the kidneys, and bodily resistance to disease. An annual grant has been given to Dr. May Wilson's clinic in New York for rheumatic fever. Large sums have gone on one hand to the advance of medical teaching, and on the other to fellowships for young post-graduates in medicine. Harkness built ten hospitals. In these, mostly in the rural south, as in Virginia and Tennessee, he took a steady personal interest. In one area, Rutherford County, Tennessee, the Fund has for fifteen years served the cause of public health, and has strikingly reduced the death-rate there from typhoid fever, diarrhœa, tuberculosis and puerperal fever together with infant mortality. Only a fortnight before Harkness died he announced the enlargement of two of his hospitals in this region. But apart from this medical philanthropy, Harkness will be chiefly remembered in America for his great gifts to Harvard and Yale Universities—about £6,000,000 altogether—for a scheme under which those unwieldy institutions were enabled to build separate colleges—seven at Harvard and nine at Yale—after the plan of Oxford and Cambridge, and at last give staff and students an opportunity to become individuals.

A reticent and diffident man, Harkness used to say he devoted almost as much time to shunning publicity as to studying philanthropy. A widow survives him, but no children. WILLARD CONNELY.

[It has been announced that Mr. Harkness has left the bulk of his estate, which is believed to exceed 100,000,000 dollars, in trust to his wife. After her death it is to be divided among twelve institutions including: the Commonwealth Fund, the College of Physicians and Surgeons of Columbia University, Harvard University, Yale University, and Atlanta University.]

WE regret to announce the following deaths:

Prof. Alexandre Desgrez, a member of the Section of Free Academicians of the Paris Academy of Sciences, and professor of medical physics in the Faculty of Medicine, University of Paris, on January 20.

Prof. S. J. Hickson, F.R.S., emeritus professor of zoology in the University of Manchester, on February 6, aged eighty years.

Mr. H. I. Smith, formerly chief Dominion archæologist and assistant director of the Canadian National Museum, aged sixty-seven years.

NEWS AND VIEWS

Horace Bénédict de Saussure (1740-1799)

ON February 17 occurs the bicentenary of the birth of the celebrated Swiss naturalist and geologist Horace Bénédict de Saussure. He was born at Conches, near Geneva, in which city he passed most of his life and in which he died on January 22, 1799. As a boy he was a diligent collector of plants and minerals, being stimulated in his studies by his uncle, the naturalist Charles Bonnet (1720–93). At the age of twenty he made his first tour to the glacier of Chamonix, an excursion regarded generally as dangerous. This was the beginning of his many journeys in the Western Alps and his travels in England, Germany, Sicily and Italy. At the age of twenty-two he was given the chair of physics and philosophy at the Academy of Geneva, and this post he held until 1786 when he resigned and was succeeded by his pupil Marc-Auguste Pictet (1752–1825). Among his earliest writings was a volume on electricity published in 1766. Year by year he extended his knowledge of the Alps, and in 1787 on August 2 with Michel Cachet he ascended Mont Blanc. The first Englishman to make the ascent, Mark Beaufoy (1764–1827), reached the summit a week later. In 1788 Saussure spent about a fortnight on Col du Géant and between 1789 and 1792 climbed Monte Rosa, the Breithorn, and other mountains. The upheaval in Switzerland due to the revolutionary movement in France drew him for a time into political life, but in 1794 most of his activities were brought to an end by a stroke of paralysis. From this he never really recovered.

Saussure's great work "Travels in the Alps 1779–1786" was described by von Zittel as a model of clear language, exact observation and cautious reasoning. His "glowing descriptions of the Alpine world removed the prejudice against the 'Montagnes Maudits', and awakened a feeling of enthusiasm for the infinite wonderland of beauty and delight in the higher altitudes of the Alps. Apart from his achievements in science de Saussure may be regarded as the pioneer of a practically new cult in human enjoyment, the love of mountain climbing". As a geologist de Saussure's aim was to observe, and to observe accurately. He examined the mineral composition of the rocks and studied their topographical, meteorological and physical relations on the mountains. He improved the hygrometer and the anemometer and devised a cyanometer and a diaphonometer for comparing the degrees of transparency of the atmosphere at different altitudes. Half a century after de Saussure's stay on the Col du Géant, J. D. Forbes visited the same spot and in 1843 he wrote in his "Travels through the Alps of Savoy" that "No system of connected physical observations at a great height in the atmosphere has ever been undertaken which can compare with that of de Saussure. At any time such self-denial and perseverance would be admirable; but if we look to the small acquaintance which philosophers of sixty years ago had with the dangers of the higher Alps, and the consequently exaggerated colouring which was given to them, it must be pronounced heroic".

A biography of de Saussure was published by Dr. Douglas Freshfield in 1920 and was reviewed by Prof. T. G. Bonney in NATURE of February 10, 1921.

Evacuation and the Schools

LORD DE LA WARR's recent speech as President of the Board of Education in the House of Lords in reply to a motion by the Archbishop of Canterbury has been sent out as an announcement of the Board. It is a timely recognition that educational affairs in Great Britain are not as they should be, and that improvements are needed at once. Granting that the wholesale evacuation of children was a necessary and difficult process, more pains should have been taken to cope with the problems to be faced, one of which, now urgent, is an increase of illness at this time of the year. Every schoolmaster knows the dangers of the Easter term. Things have been done in a hurry and in alarm which should certainly be undone. An important school in a non-danger area was closed until further notice and reopened when better sense prevailed; much of the commandeering or use of school buildings for Government officials or civil defence was unwarranted, and its extent has been reduced.

The President of the Board says nothing of buildings long condemned as unsatisfactory and remaining unrepaired. Children lounging about the streets are a nuisance to themselves and everybody else, and rapidly deteriorate. This misguided leisure is being rectified by the allocating of camps and hiring of extra halls. Authorities have been told that children may be admitted to school before protection is completed. The 400,000 at present "receiving no schooling or care at all" present an urgent problem. In some cases "provision has been made and the children are not attending", and it is stated there are those who "bolster up evacuation by keeping schools closed". The announcement of compulsory school attendance for older children is a step in the right direction. Examinations should go on and full-time schooling be made compulsory as soon as possible. Lord De La Warr realizes that "education is not less important in wartime but more so". At a national conference of secretaries of the National Union of Teachers, a resolution was passed warmly welcoming "the decision of His Majesty's Government to enforce compulsory school attendance in evacuable areas no less than in neutral and reception areas".

Evacuation and Science Work in Schools

THE transference of schools from 'vulnerable' to 'safe' areas in Britain, where they now work in conjunction with other schools of the same type, was a necessary part of the scheme adopted at the outset of the War to minimize loss of life in the event of air attacks upon the civil population. Since last September, normal educational work has therefore not been possible for a very large number of secondary school pupils, and whatever gain there may have been for those from towns coming into closer contact with Nature, it is perhaps offset by reduced teaching and laboratory facilities. Even the better equipped of secondary schools cannot be expected to accommodate double the usual number of science classes, and though in many instances the amount of time devoted to science subjects has not been seriously curtailed, the work is often done in unfavourable circumstances, especially as regards the senior work. It is difficult to accommodate all the senior students in the small advanced laboratories found in most secondary schools even when a system of 'double shifts' is arranged, so that practical work has suffered more than theoretical teaching. The standard of proficiency of pupils who will leave school this year to continue at the universities will be examined with much interest. That the experiment of evacuating schools was a wise one, despite the dislocation involved, there can be no doubt, and the authorities are doubtless watching its consequences so far as secondary and higher education is concerned.

Health of the School Child

SIR ARTHUR MACNALTY's report for 1938 on "The Health of the School Child" has been issued by the Board of Education (H.M. Stationery Office. 1*s*. 3*d*.). The introduction considers the circumstances rendering necessary the evacuation of school children from large urban centres of population and its effect upon the school medical service. During the year the nutrition of 1,674,023 children was assessed at routine medical inspections, and 14·5 per cent were found to be excellent, 74·2 per cent normal, 10·8 per cent subnormal and 0·5 per cent bad. During twenty years, improvement in the nutrition of the school child is striking. Thus in Sheffield, compared with 1920, five-year-old boys average nearly 2 inches taller and 3 lb. heavier, and five-year-old girls 1·4 inches taller and 1 lb. heavier; twelve-year-old boys are more than 2 inches taller and 9¾ lb. heavier, and twelve-year-old girls 3 inches taller and no less than 12·4 lb. heavier. The numbers of children in receipt of free meals or milk continue to increase—from 535,300 in 1936–37 to 687,855 now—and the milk-in-schools scheme is in operation in 87 per cent of public elementary schools. Much information is given respecting medical inspection and treatment, hearing of children, the school dental service, and the care of the young child.

Rhodes-Livingstone Institute, Northern Rhodesia

A BRIEF note on the work of the Rhodes-Livingstone Institute since its inception in 1937 prefaces a contribution on "Anthropology as a Public Service" by Mr. Godfrey Wilson in the current issue of *Africa* (13, 1; January 1940). This Institute, it may be remembered, was founded largely through the efforts and interest of Sir Hubert Young, then governor of Northern Rhodesia, and was the first institute for systematic sociological research to be established in colonial Africa. In the words of the founders, it was intended "as a contribution to the scientific efforts now being made in various quarters to examine the effect upon native African society of the impact of European civilization." In the first instance, funds were asked for three years only, with a view to a special appeal in 1940, a year specially linked with the two men whom the Institute commemorates. It is the centenary year of Livingstone's departure for Africa and the jubilee year of the foundation of the two Rhodesias by Cecil Rhodes.

The Institute is not a Government department but an independent body governed by trustees. Although for the moment the bulk of the income is derived from Northern Rhodesia, contributions are made by all the Governments from Southern Rhodesia to Uganda. Not only has the museum founded in memory of Livingstone in 1934 been incorporated in the Institute, its curator acting as the secretary, but also two research officers have been appointed, of whom Mr. Wilson is one, and the results of their investigations will be published in a series, the *Rhodes-Livingstone Papers*, to which non-members are also invited to contribute.

Pioneers in Amerindian Portraiture

THE February issue of *Man* is a Catlin centenary number, and Mr. L. J. P. Gaskin recalls that on February 1, 1840, George Catlin, artist, traveller and ethnographer, opened his North American Indian Museum and Gallery in the Egyptian Hall, Piccadilly, London (see also NATURE, January 27, p. 158). Catlin was a self-taught artist and ethnographer. By contrast, Paul Kane (1810–71) was an artist by training and profession, and in his home in Toronto he had been familiar with the appearance and dress of Indians of various tribes who visited that seat of government. After travelling in the United States and studying in Europe, he set out on the first of his two expeditions among the Indians in 1845, when he spent five and a half months in recording portraits of "the principal chiefs, and their original costumes to illustrate their manners and customs, and to represent the scenery of an almost unknown country". In 1846 Kane started on his second and more important journey, which occupied two years and six months and extended across the continent to Fort Victoria. He did not keep a journal during his travels, and his book "Wanderings of an Artist among the Indians of North America" (1859) appears to have been written from memory.

Kane's sketches, exhibited on his return, attracted much interest, and a number of pictures were commissioned from him, some by the Government. Some of his pictures are now in the National Gallery, Ottawa, the House of Commons, Ottawa, and the Royal Ontario Museum of Archæology, Toronto. Of his field sketches, some are likewise preserved in Toronto, while a number are in the possession of David I. Bushnell, jun. Reproductions of these have now been published with an account of the artist's life and work by the present owner (*Smithsonian Miscell. Collect.*, **99**, 1; 1940). They show a number of variations, important in an ethnographical sense, from the studio portraits and studies painted later.

Tibetan Ceremonial and the Dalai Lama

SINCE the revelation of the reincarnation of the late Dalai Lama in the body of a small boy and his entry into Lhasa, further observances of the ritual ceremonial have affirmed the youthful succession in his position—in this instance all the more necessary in view of the slight discrepancy between his age and the period of time that has elapsed since the death of his predecessor. Among these is the assumption of the new name or names by which the Dalai Lama will be known officially in future. These are, it is stated (*The Times*, February 9), Jampel Ngawang Lobsang Yishey Tenzing Gyatso, of which the meaning is "Tender Glory, Mighty in Speech, Excellent Intellect, Absolute Wisdom, Holding to the Doctrines, and Ocean-Wide". These names derive from titles of former Dalai Lamas, including the first, which was bestowed by the Mongol prince Yushi Khan.

Large numbers of Buddhist priests and nuns are now present in Lhasa for the installation ceremonies, and have attended the ceremonial performances which have taken place in the courtyard of the Potala, the vast monastic establishment in which the Dalai Lama resides. The important part of the New Year observance, as with many primitive peoples, and also among the more primitive of the European peasantry even to-day, is the ceremonial of driving out all the evil influences of the Old Year. In Tibet this is of especial significance in view of the element of 'devil-worship' which has been introduced into the practices of Tibetan Buddhism, and the ecstatic 'devil-dances' in which its followers indulge more especially in eastern Tibet.

On this occasion, it is reported in a dispatch from Lhasa (*The Times*, February 12), the dancers, wearing masks representing the heads of stags or bulls and grinning skulls with fangs, enacted the reception for the skeleton dance which was performed by four skeleton dancers, with two attendant death's heads, scattering ashes. A magician wearing an apron of bones and a tall black hat topped with a fan-shaped ornament conjured spells from a skull while spinning in a rhythmic dance, which was the preliminary to ceremonies performed over an artificial corpse, which no doubt represented the Old Year, although this is not stated. Fire, as always a purificatory agent, appeared in the ceremonial when pictures of Tibetan devils were burned.

Forgotten Methods of Painting

IN his discourse on "Forgotten Methods of Painting" at the Royal Institution on February 2, Mr. Hesketh Hubbard spoke of the almost forgotten *sfumato* and *botizar* systems of oil painting, and dealt with the method of dusting dry powdered pigment over a sticky mordant which was used by some of the sixteenth and seventeenth century painters for laying certain pigments—a method known as 'strowing'. He outlined the technique of the fourteenth century English painters who worked in water-colour on woven linen; the linen was first saturated with gum-water, and then stretched over coarse woollen and frieze cloths which absorbed most of the colour, leaving the linen transparent after painting. The method of elydoric painting, or painting miniatures in oil whilst the painting ground was submerged in water, and the techniques of encaustic painting were among the topics mentioned.

In his ceaseless search for new pigments, before the chemist rendered him much assistance, the painter had not despised even the food upon his table. The great Paul Sandby himself had converted into pigment burnt crusts and peas that had been cooked to a cinder. Mr. Hubbard said that there is no reason to suppose that the painter has discovered all the manifold uses of his materials; the more media he has at his disposal the less restricted will be the mental outlook of the painter. Every medium of painting shares a frontier with one or more other media. At one point tempera touches fresco; at another it borders on oil painting. Glass painting and enamelling share much in common. It is along these frontiers, in the region of mixed methods, that the painter, in these latter days of painting will, in Mr. Hubbard's opinion, find the most profitable fields for experiment and research. For the same reason, the painter and student might profitably turn their attention, at least in their leisure hours, to some of the forgotten methods of painting.

Lunar Tide in the Atmosphere

THE *Meteorological Magazine* of December 1939 contains a summary by Prof. S. Chapman of his presidential address to the Association for Meteorology at the Washington Assembly of the International Union for Geodesy and Geophysics last September, the subject being the lunar tide in the atmosphere. The author describes the difficulty that was met when the detection of this lunar tide, achieved first by Lefroy in 1842 for St. Helena, was attempted for higher latitudes, which resulted in a succession of failures that was not broken until his own determination in 1918 of the very small Greenwich air tide, from sixty-four years of hourly data. From that year, when the tide was known for three tropical stations and one non-tropical, progress was rapid, and the rate of determination by Prof. Chapman and his assistants was increased threefold in 1930 through a loan of Hollerith machines by the British Tabulating Machine Co. Now the tide has been determined for more than fifty places.

With this number of determinations available for study of the world distribution of phase and amplitude, several interesting peculiarities have come to light; for example, an early maximum is shown at Salt Lake City, San Diego and San Francisco, this being two hours before the upper and lower lunar transits at the last two places, but at the neighbouring high-level stations of Mount Wilson Observatory and Mount Hamilton (Lick) the tide, although similarly small for the latitude, has roughly the normal phase with high tide after the moon's transits, an effect doubtless due to the presence of the great mountain chain of North and South America. Similar effects are, however, not shown by Kodaikanal and Periyakulam, in India, although the heights of those places differ more than do those of the American stations, the differences being as much as 2,249 metres. Equally remarkable is the practically world-wide retardation of the time of high tide in December and January as compared with April or May, in spite of the fact that summer in one hemisphere corresponds with winter in the other. Work has been begun on the determination of the air currents of period equal to half a lunar day that must be associated with the pressure tide; this problem is being attacked with the aid of the long record available at Batavia.

Ultra-Violet and Infra-Red Radiations on the Farm

L. C. PORTER, of the General Electric Company's incandescent lamp department in Cleveland, said, at a meeting of the American Society of Agricultural Engineers held on December 7, that if only electric current becomes cheap enough and suitable equipment is developed, then ultra-violet and infra-red radiations can have many uses on the electrified farm of the future (Science Service, Washington, D.C.). Adaptations of the familiar dull-red glowing electric heaters can readily be made for use in poultry-houses, in barns to keep new-born animals warm, and for the quick drying of hay. The greater compactness and decreased fire risk will give them considerable advantage over present types of equipment. Ultra-violet rays are known to have certain well-marked physiological effects, as in activating sterols to produce vitamin D and in keeping in check the growth in length of plants. For producing well-proportioned plants in greenhouses, the use of a new kind of incandescent lamp is suggested which has a globe permeable to ultra-violet as well as to visible rays.

With these and other lamps in proper proportions, a close approximation to natural sunlight can be obtained with control of duration and intensity not possible under natural conditions. The well-known germicidal effects of ultra-violet rays still await a number of possible practical applications on the farm. They may be used, for example, in dairies and stable buildings, as they now are in hospitals to keep down the germ population of the air. They may be called on to control the spread of epidemics among farm animals, and to check the growth of moulds and other fungi on hay, grain and other products. Their fluorescent effects may aid in diagnosing animal diseases and in examining vegetables and fruits. With Dr. Buttolph, physicist of the General Electric Company, Mr. Porter is publishing some of his suggestions in *Agricultural Engineering*.

Helium Production in the United States

THE developments of the last twenty years in helium production in the United States are described in *Engineering* of January 26. Reference is made to a lecture delivered recently in the College of Engineering of the University of Maryland by Dr. C. W. Siebel, supervising engineer of the Government-owned helium plant near Amarillo, Texas, and to a memorandum issued by the United States Bureau of Mines. The present helium-producing plant at Amarillo has a capacity of 24 million cubic feet of helium of 98·2 per cent purity a year, but it is stated in the Bureau of Mines memorandum that, by installing another production unit in existing buildings, the output could be raised to 36 million cubic feet a year. As the present military and commercial requirements, aggregating approximately 6 million cubic ft. a year, are met by operating the plant at about one quarter of the installed capacity, there is a large reserve for emergencies.

In addition to the Amarillo installation, the U.S. Government owns two smaller helium plants, at Dexter, Kansas, and at Thatcher, Colorado; these are not being worked. They were built by private interests and purchased by the Government in 1937. To supply the Armarillo plant with helium-bearing natural gas, the Bureau of Mines has purchased all gas rights in 50,000 acres of land comprising the Cliffside gas field. It is stated that, on the basis of a conservative estimate, the Cliffside area contains at least 100,000 million cubic feet of natural gas having a helium content of 1·8 per cent. This is equivalent to a reserve of 1,800 million cubic feet of helium, or approximately two hundred times the average annual production during the last ten years. In addition to the resources at Cliffside, the U.S. Government possesses two helium reserves in Utah, which are being retained for future needs.

Mineral Resources of the British Empire

DURING the War of 1914–18 a Royal Commission formed the conclusion that an Empire Development Board was desirable, and there the project has been allowed to rest. An editorial article in *Sands, Clays and Minerals* (autumn issue, 1939) urges that no time should be lost in an intensive survey of the mineral resources of the Empire. The War, so far from causing a postponement of such a survey, should hasten it, and the survey must be carried out from a national point of view regardless of the possible financial profit that may accrue from the mining of any mineral. We cannot afford to wait while commercial interests debate the potential profit in a new venture: access to new supplies of a mineral ore may be vital to victory. The writer makes it clear that he is not thinking in terms of politicians and their methods of control. In that direction he foresees no hope of initiative. If anything is to be done, technologists will have to get together and do it for themselves.

It is proposed that the scientific men of Great Britain should draw up a scheme of Empire development, communicate it to corresponding groups in the Dominions and Colonies, and then give the plan such publicity that even the dead hand of the politician could not destroy it, and possibly some public-spirited men might launch the venture free from the shackles of official control. Emphasis is laid on the conception of a just minerals policy for the Empire in the peace that is to come, the necessity for preventing the exploitation of resources falling to the wrong kind of private enterprise in which profits are the one consideration, and finally the desirability of making the Empire's mineral resources available to all.

An Artificial Mastoid for Audiphone Measurements

THE *Bell Laboratories Record* of November 1939 contains a paper on the development of bone-conduction audiphone receivers by M. S. Hawley, of the Transmission Instruments Engineering Department of the Laboratories. To provide a method of measuring the response of bone conduction receivers under the correct mastoid load, an artificial mastoid was developed. The impedance offered by the mastoid to a bone conduction receiver was measured on a number of people and then a rubber block was designed that presented to a receiver placed upon it approximately the same impedance as the average human mastoid. Since the artificial mastoid is based on average values of mastoid impedance, there may be slight variations in the results obtained with it and with some particular subject. The possible deviations are indicated by a diagram, which shows responses obtained with the artificial mastoid and with one particular subject. At very low frequencies here is an evident slight departure, but over the major part of the frequency range the results are in close agreement. Measurements on the same instruments made over a period of a year have shown very good correlation. Eventually the rubber pad ages and its impedance changes. The replacement of the old pad by a new one is a simple matter, so that the ageing of the rubber pad is not of much consequence. The artificial mastoid may be used in making other tests on receivers in which it is desired that the receiver be coupled to an impedance load equal to that of the head. Such tests include electrical impedance measurements, rattle tests, and non-linear distortion measurements.

Earth Tremor in New Jersey

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has now determined the epicentre of the earthquake of November 14, 1939, to have been near lat. 39° 45′ N., long. 75° 18′ W., which is only 10′ due south of the point suggested as being very near to the epicentre by the Franklin Institute at Philadelphia. The depth of focus is estimated as having been about 25 km.

We are indebted to Prof. William A. Lynch, of Fordham University, New York, for the information that in the summer of 1938 a series of local shocks occurred to the north-east of the above epicentre in the region of lat. 40° 8′ N., long. 74° 32′ W., the two most severe of which were on August 23 at 3h. 36m. and 7h. 3m. G.M.T. On the basis of a canvass of volunteer correspondents and observers, the Coast and Geodetic Survey then announced that the intensity of these "apparently did not exceed V according to the Modified Mercalli Scale of 1931" (felt by nearly everyone; many awakened; some dishes, windows, etc., broken; a few instances of cracked plaster, etc.). The earth tremor was not strong enough to be registered on the seismographs at Kew Observatory. "Earthquake History of the United States", part 1 (1938), published by the Survey, lists only four moderately strong earthquakes for New Jersey up to the year 1936. In our previous note on the earthquake (NATURE, Nov. 25, 1939, p. 904) New Jersey was wrongly stated to be one of the New England States.

Central European Observer

WHEN the Czech nation lost its independence in 1620 its cultural life ceased. Yet Comenius and other teachers continued their educational work in exile. To-day, the nation is again under foreign domination, its universities and scientific institutions are closed and its cultural publications no longer appear in the country itself. One has, however, resumed publication in London. From 1923 until the end of 1938, there appeared in Prague the *Central European Observer*, a review in English dealing with science, art, literature and industry and with European affairs generally. In common with other Czech cultural reviews, it suspended publication after the virtual loss of independence in 1938. It is now appearing again as a fortnightly journal "to study, as it had done in Prague, the problems of the Danubian basin with special attention to the peaceful collaboration of peoples inhabiting it, in the new Europe which must arise from the present cataclysm".

The *Central European Observer* was always well informed on scientific as well as other matters, and gave readable accounts of archæological, biological, chemical, physical and other scientific discoveries and advances made in Central Europe, and its industrial sections frequently referred to new technical applications of scientific knowledge. The first issue of the new series, which retains most of the features of the former *Central European Observer*, contains an article by the late Karel Čapek entitled "The Death of Archimedes".

American University Education

A DECEMBER number of *School and Society* opens with "Statistics of Registration in American Universities and Colleges, 1939", a remarkable survey by the president of the University of Cincinnati. No fewer than 648 institutions are noticed with various comments in detail, and one realizes the vast attendance in a population, perhaps, four times as big as that of Great Britain. The figures, 873,697 full-time students, and with part-time and summer schools, 1,323,874, show an advance on 1938. The United States spends more of its holidays in learning than Great Britain does, though some of the instruction provided and degrees awarded do not reach the British level of attainment. The south-central divisions of East and West and teachers' colleges and technological institutions show the largest increase. In the Freshman Table the trend of the time appears in the 34 per cent additions to engineering, and we are glad to see a distinct though lesser gain in liberal arts. The establishment of a Graduate School of Education at Los Angeles may in time modify the crudities of American films and scenario writers.

Whales

UNDER the title of "Whales, Giants of the Sea", Mr. R. Kellogg contributes to the *National Geographic Magazine* of January a long article on whales and whaling which is specially noteworthy for the detailed notes on the size, appearance, distribution and habits of more than thirty species of cetaceans and coloured illustrations of nearly every species. Each illustration depicts the whale at sea, often feeding, sometimes in contact with its enemy and frequently in schools. These pictures probably constitute a unique gallery and are of considerable value.

Society for the Bibliography of Natural History

AT the annual general meeting of the Society for the Bibliography of Natural History held on February 3, the following officers for 1940 were elected: *President*, Dr. C. Davies Sherborn; *Treasurer*, Mr. Francis Hemming; *Secretary*, Mr. Francis J. Griffin. The Treasurer's report indicated that the Society's financial position is strong; but the need for new members was stressed if the Society is to continue its activities on the present scale. It was reported that a fund has been set up for the publication of facsimiles of rare works, and the president, Dr. C. Davies Sherborn, has started the fund with a handsome donation.

Aftershocks of the Earthquake in Turkey

THESE still continue in considerable numbers and some reach a high intensity. In the Erzinjan area the two villages of Besin and Pulur were destroyed by a shock which killed forty-five people and injured many more on February 3. On February 4, tremors were felt at Ankara, Sivas and Zara, and a village was destroyed, killing ten people and seriously injuring three others.

The Colonial Service: Recent Appointments

THE following appointments and promotions have recently been made in the Colonial Service: M. Halcrow, agricultural officer, Kenya, agricultural officer, St. Helena; T. D. Marsh, agriculturist, senior agriculturist, Malaya; F. R. Mason, deputy director of agriculture and fisheries, director of agriculture and fisheries, Palestine; R. Smeathers, assistant conservator, Tanganyika Territory, assistant conservator, Trinidad; T. G. Wood, senior assistant conservator, conservator, Nigeria; R. Coulthard, veterinary officer, senior veterinary officer, Nigeria; R. M. Gambles, veterinary research officer, Palestine, veterinary officer, Cyprus; D. R. R. Burt, lecturer and head of Department of Zoology, professor of zoology, University College, Ceylon.

Announcements

THE Harben Gold Medal for 1940 of the Royal Institute of Public Health and Hygiene has been awarded to Sir Leonard Hill, formerly professor of physiology in the University of London. The Smith Award for 1940 has been conferred on Sir William Savage, formerly medical officer of health, Somerset.

AT a meeting of the Royal Astronomical Society held on February 9, the following officers were elected for 1940–41: *President*, Prof. H. C. Plummer; *Vice-Presidents*, Prof. David Brunt, Prof. Alfred Fowler, Dr. H. Spencer Jones, Sir James Jeans; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Dr. R. d'E. Atkinson, Mr. D. H. Sadler; *Foreign Secretary*, Sir Arthur Eddington.

THE annual prize awarded by the Royal Asiatic Society for its universities prize essay has been awarded this year to Mr. Asa Briggs, of Sidney Sussex College, Cambridge. Of the subjects offered, Mr. Briggs wrote on "The Influence of Sea Power on the History of the East India Company".

THE Sixth International Congress for Experimental Cytology, which had been arranged to take place in Stockholm during July 25–August 1, 1940, has, on account of the international situation, been postponed indefinitely.

PROF. BIDHAN CHUNDER ROY, of Calcutta, has been elected president of the Medical Council of India in succession to Major-General E. W. C. Bradfield. Prof. Roy is the first non-official president and the first Indian to hold the office.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 267. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Anthropological Nomenclature

ANYONE who has followed the revelation of new knowledge on Pithecanthropus and Pekin man by Weidenreich and von Koenigswald in the columns of NATURE and elsewhere during recent months cannot but agree with the opinions expressed by Prof. Le Gros Clark[1]. If the usual rules of nomenclature are to be followed, the generic name Sinanthropus must now be regarded as a synonym of Pithecanthropus.

Prof. Le Gros Clark's letter raises once more the whole question of nomenclature in physical anthropology. To put the matter briefly, the naming of the forms of recent and fossil man is in a chaotic state, and the misuse of the term 'race' in anthropological literature has long been a matter for adverse comment. Several ineffectual attempts have been made to rectify matters, most of them over-enthusiastic; for example, those of Sergi[2] (1908) and of Pycraft[3] (1925).

To be consistent, the same general principles should be adopted as in dealing with other zoological groups. Differences within the family Hominidæ may be of three or more orders, and in assessing the value of physical (including morphological, physiological, serological) differences the following general principles should be followed.

(1) *Generic* differences involve differences in external or internal anatomical structure. Examples: the differences between a lion (Panthera) and a cat (Felis), or those separating Pithecanthropus from Homo.

(2) *Specific* differences involve no differences in structure. They include differences in bodily proportions (total size or relative differences in appendages); differences in bodily form; constant major differences in coat pattern, or the distribution of pigment in skin and hair. Specific characters are not necessarily associated with geographical range. Examples: the differences between lions and tigers, or between Negroes and Mongoloids.

(3) *Subspecific* (syn. racial or geographic variational) differences are those occurring between the members of a widely distributed species, and are correlated with climatic and other geographic factors, although experimental removal to other localities proves the characters to be usually fixed. Subspecific differences include differences in colour and texture of pelage; variations in length of coat, or of its special peculiarities (manes, crests, etc.) and minor differences in pigmentary pattern. Examples: the differences between the lions of Asia and those of Africa, or between, say, American Indians and typical Mongoloids.

It is essential that the term 'race' in anthropology be synonymized with 'subspecies', and used for no other purpose. By so doing considerable confusion at present existing will disappear. Groups of Hominids of lesser rank than subspecies should be designated 'peoples' (*populi*), and this term should likewise be restricted to this usage. Linguistic differences should on no account be utilized alone in physical anthropological diagnosis, though they may carry weight as confirmatory evidence.

Mutants are not synonymous with subspecies, though they may be subspecies in the making. Commonly but single individuals or small family groups (for example, of albinos) are concerned, but sometimes, as in certain lower Primates, whole colonies of mutants occupy certain localities to the exclusion of the normal form. Where a particular mutation is common, it may affect all the subspecies of a given species (for example, partial albinism in the monkey *Kasi senex* in Ceylon).

Interspecific hybridism is unusual, though not unknown in Nature. It is commoner under domestication, hence frequent in Homo, the most completely domesticated of all animals. Fertility of the hybrids will depend on chromosomal compatibility or the reverse.

Intersubspecific hybridism is the rule where two subspecies meet in Nature, as on the geographic frontiers, where intermediate types are usually found. Chromosomal incompatibility is lacking; if it were not, the differences would be of specific rank. Geographic separation is normally the only barrier to complete commingling of subspecies, with the consequent swamping of the differences; but in man, artificial barriers, such as caste, constitute additional factors tending to isolate breeding groups.

It remains to apply the above generalizations to the members of the family Hominidæ, both recent and fossil. There seems to be no dissenting voice to the generic separation of Pithecanthropus and Pekin man from other Hominids, but most anthropologists lump all or nearly all the remaining forms under Homo, and even under a single species thereof. It is manifest that, if the above principles are observed, the Neanderthaloids at least require generic separation, and this has already been suggested by some, the name Palæanthropus Bonarelli being available.

Most isolated new discoveries of fossil man are automatically placed under Homo and labelled with a specific name based on the locality of the discovery. This procedure has been very loosely carried out in the past, without waiting for complete examination of the specimen or comparison of its status with known forms. It is generally merely to serve as a label for description of the specimen. For example, we have *Homo modjokertensis*, which, with advancing knowledge, proved to be a juvenile Pithecanthropus, and *H. kanamensis*, based on a mandibular fragment.

On the other hand, many anthropologists, disregarding the rules of nomenclature, relegate all forms of Homo that do not differ structurally from what they loosely term 'modern man' to the sole species *Homo sapiens*, irrespective of geological age, geographical distribution or differences of a specific order.

The problem of the conspecificity of all living humanity has always been a thorny one. Allowing, however, for modern concepts of the status and limits of 'species', there is no reason to assume, as was once done, that acceptance of several species of living Homo necessarily implies a polygenic origin. If we are to be consistent and adhere to the general principles enunciated above, it is impossible to escape the view that there are several 'species' of living man, and several more fossil kinds. Moreover, some, if not all, these species have evolved geographical variants requiring trinomial nomenclature.

Many changes will be required if the above argument is to be acted upon, and new definitions will have to be prepared in certain cases. There will, no doubt, be plenty of scope for differences of opinion, but in any event the adoption of this or some similar scheme will assist in smoothing out considerable confusion. Space forbids the discussion of any details here, but one point that particularly comes to mind is the necessity of restricting the term *Homo sapiens* either to 'white man'—in which case Mediterranean, Alpine, etc., will become subspecies of it—or to some particular group of Europeans.

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[1] Le Gros Clark, W. E., NATURE, **145**, 70 (1940).

[2] Sergi, G., *L'Uomo* (1908).

[3] Pycraft, W. P., *Man* (1925).

Scope and Limitations of Physical Anthropology

RECENT statements regarding physical anthropology are full of interest, but they omit the practical issue, which is the definition of a standard. During 1917–18, I was a medical officer employed in Egypt to assess the physical and mental capacity of soldiers, and decide who should be put into front line service and who should be employed in supporting services and in what capacity.

The story of national efficiency soon revealed itself. It is set out in a work of mine called "A Vision of the Possible". Some soldiers saw sufficiently well with glasses, some had some defective hearing on one side, and some had a varicose vein. I did not regard the vast majority of these as physically deficient, and, with the exception of those who had some ear disease, I could not see how anything could have been done to prevent these conditions. A vast number had bad teeth and were relegated at once to a large number of dentists stationed close to the front line, and were duly attended to.

In this respect I think something could be done in the way of national prevention. I believe I am correct in stating that the predynastic Egyptians, the original Hawaiian and Maories and the uncivilized (if it is justifiable to use such a term) Australian aborigines all had good teeth. The recent publication of the elaborate uncultivated diet of the Australian aborigine explains why he lived and thrived where civilized man died of starvation. But the Pharaohs suffered from dental disease, and so do the other races named, since contact with Europeans and different foods.

In the course of my work I realized that if the defects mentioned were regarded as barriers, there would be a sadly depleted army, and I am grateful that the commander-in-chief, Lord Allenby, endorsed this view and our action.

In the course of an investigation made long since, Lang and I found that in most wild animals refractive errors were not common, though certainly met with in some of the marsupials which have almost rudimentary eyes. But gross errors of myopia, hypermetropia and astigmatism were met with in many domesticated animals.

It is more than evident that Le Gros Clark, Mellanby and others have a powerful case for inquiry on the broadest basis possible, for the problem is not simple. But I conclude by stating that if you reject one man for refractive error, another for defect in one ear and so on, you get an utterly false standard of physical efficiency, and for that reason the usual figures given for rejection from the army never make any serious impression on me, as I think they do not express the common sense of the problem.

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Jan. 3.

Blood Groups of the Angami Nagas

REFERENCE has been made in NATURE[1] to the report of the British Association Research Committee on Blood Groups among Primitive Peoples. The blood group percentages of the Angami Nagas, based on 96 tests, are given as follows:

O	*A*	*B*	*AB*
35·4	34·4	25·0	5·2

These differ greatly from those on the same people published by Capt. Mitra[2], which are as follow:

O	*A*	*B*	*AB*
46·06	38·78	11·52	3·64

The percentage of *B* given in the British Association data is thus more than double that published by Capt. Mitra and there is also an appreciable difference in blood group *O*. It is also stated in the British Association report that the blood group results accord with the view of Mr. J. P. Mills that the Konyaks are more primitive than the Angami-Rengmas, but if Capt. Mitra's Angami Naga results are compared with those of the British Association on the Konyaks, they appear to be closely similar. They are as follows:

	No.	*O*	*A*	*B*	*AB*
Angami (Mitra)	165	46·06	38·78	11·52	3·64
Konyak (B.A.)	127	45·7	40·2	10·2	3·9

The British Association results, however, confirm the predominance of *A* over *B* in this region excepting among the Thado-Kukis, which I also had pointed out in my recent paper on "Blood Grouping Investigations in India, with special reference to Santal Perganas, Bihar"[3].

S. S. SARKAR.

Bose Research Institute,
Calcutta.
Dec. 14.

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[1] NATURE, **144**, 714 (1939).

[2] Mitra, P. N., "Blood Groups of the Angami Naga and Lushei Tribes", *Indian J. Med. Res.*, **23** (1935–36).

[3] *Trans. Bose Research Institute*, Calcutta, **12** (1936–37).

Coprophagy in the Wild Rabbit

REPORTS of recent experiments by Madsen[1] and Eden[2] have shown refection to be a normal physiological process in the laboratory rabbit. A few observations collected by me, while studying the ecology and population dynamics of the wild rabbit, suggest that this process also occurs in natural conditions. From Eden's experiments, 54–82 per cent of fæces passed are shown to be normally refected, the advantage of the process to the rabbit being equivalent to "chewing the cud". It is possible that there is a further ecological advantage, which operates under wild conditions.

The population studied by me was that of a warren near Oxford, and a little more than 50 per cent of them were trapped during 1939 and marked in the ear with numbered celluloid disks, so that observations could be made from a neighbouring 'hide' and the individuals and sexes identified by means of a telescope.

Most of these observations (March 1939 to date) were made in the late afternoon, the time when wild rabbits become active and come out to feed. Generally the period of feeding activity is preceded by about half an hour, in which some, at any rate, of the inhabitants are sitting about basking or cleaning themselves. About a hundred observations (15–60 minutes) have been made to date at this hour. Another period of feeding activity is during the late night and early morning, and this is often followed by quite a long period of basking and cleaning, especially in sunny weather, though only about 5 per cent of the population remain to do this, as contrasted with 33 per cent, which is the average proportion observed feeding. About thirty morning observations have been made. In addition, about twelve observations have been made in the early afternoon during the winter. Rabbits may exceptionally feed and bask at this time, according to weather conditions.

In all these observations refection has been observed on four occasions, three times in the early morning and once in the early afternoon. It may seem curious after noting the high proportion of total fæces refected in Eden's experiments, that this was not observed more frequently; but in the first place it evidently occurs largely at night, and secondly most of it probably occurs in the burrows. It may in fact only happen rarely above ground, so that a long series of observations, such as these, is needed to record it at all. It is clear from the observations that little, if any, coprophagy takes place in the evening, even when basking and lying out occur, and that the morning is the more usual time. This is to be expected from the rhythm demonstrated by Madsen. The one afternoon observation may have been due to exceptional weather conditions (see below).

The method of taking the fæcal pellets was not the same in every case, and the rhythm also varied. One doe was watched at 7 a.m. in August; she extended one hind leg, lifted up the foreleg and bent the head straight down. Another doe, watched at the same time, in September, leaned over on one flank and bent the head round and down outside both forelegs. A third, a buck, watched at 2.30 p.m. in December, did the same as the latter without leaning over on the flank. The two does took pellets at the rate of one every 5 seconds for about 45 seconds, while the buck watched in the afternoon took them at the rate of one every 30 seconds for 3 minutes. 'One pellet' may, of course, mean a group of pellets evacuated simultaneously. The fourth instance watched was at another warren too far away for details to be made out well.

The afternoon observation was made during very cold weather, when the ground was frozen and food difficult to obtain. In this way the rabbit's coprophagy may well be of ecological importance, enabling it to do without a supply of fresh food for certain periods. I examined three rabbits, which had lain up in a bury for at least three days (the length of time traps had been set at the entrances) and in each case the stomach contained a small amount of brownish material very different in appearance from a fresh grass meal. This almost certainly consisted of fæcal pellets broken up. They must have been taken some hours before, since they showed none of the usual 'stomach pellet' shape or discreteness well known to me from examination of normal live rabbit stomachs.

Thus during difficult periods or when scared into 'lying up' during trapping operations, the rabbit may increase the degree of refection. It would be interesting in this connexion to have counts of normal diurnal pellets produced under different environmental conditions. The ability of the rabbit to lie up for as much as a week at a time in unfavourable conditions is remarkable and is an important factor in forming policies of extermination. The degree to which refection is bound up with this ability is also important and deserves further attention.

H. N. SOUTHERN.

Bureau of Animal Population,
University Museum,
Oxford.
Jan. 13.

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[1] Madsen, H., "Does the Rabbit Chew the Cud ?" NATURE, 143, 981 (1939).

[2] Eden, A., "Coprophagy in the Rabbit", NATURE, 145, 36 (1940).

Growth Behaviour of Plants following Seed Treatment by Organic Mercury Compounds

ALBINISM in citrus seedlings is not uncommon. Frost[1] suggests that its frequent production by some parents may be due primarily to heterozygosis for various genes for albinism, and perhaps to the presence of unstable genes such as occur in cases of variegation in other plants.

Successful control of seedling albinism in citrus has been achieved in Palestine[2] by treating the seeds in a 1 : 1,000 solution of 'Uspulun' or 'Ceresan' in water.

In this connexion, Perlberger and Reichert[3] state that albinism can also be controlled by dipping the seeds in salt solutions of other metals, including lead, copper, cobalt and nickel. From this they argue that albinism in citrus is a constitutional property inherent in the plant, which manifests itself only at germination and is probably due to a disturbance of the enzymatic systems of the plant at this stage. This is borne out by the fact that salts of heavy metals which are known to have an effect on enzymatic systems cause citrus seeds to produce normal seedlings.

An alternative explanation, however, may possibly be found in a recent communication by Kostoff[4] reporting the induction of atypical growth and chromosome doubling in Gramineæ after treatment with the fungicide 'Granosan' (ethyl mercury chloride). It is conceivable that control of albinism is associated with the induction of abnormal mitosis as the result of seed treatment by organic mercury salts.

The beneficial effects in respect of germination and freedom from seed-borne diseases following the treatment of seed by organic mercury dusts are well known.

Some curiosity has been expressed at the high yields thus obtained with cotton[5], and the opinion has also been advanced that a factor other than the control of seed-borne disease must have entered into the effect.

It would undoubtedly be of interest and importance to investigate this matter more closely in order to determine the correct explanation of these phenomena.

G. R. BATES.

Citrus Experimental Station,
P.O. Mazoe,
Southern Rhodesia.
Jan. 8.

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[1] Frost, H. B., *Hilgardia*, 1, 365 (1926).

[2] Reichert, I., and Perlberger, J., *Bull. Agric. Res. Stat., Rehevot, Palestine*, 22 (1936).

[3] Perlberger, J., and Reichert, I., *Bull. Agric. Res. Stat., Rehevot, Palestine*, 24 (1938); (abstract in *Hort. Abs.*, 9, No. 3 (1939): only this seen).

[4] Kostoff, D., NATURE, 144, 334 (1939).

[5] Miles, L. E., *Phytopath.*, 29, 986 (1939).

Identity of the Bacterium Causing Potato Blackleg

As a result of the comparative study of Leach[1], the blackleg disease of potatoes is now generally ascribed to *Bacterium carotovorum*, which is also responsible for the soft rots of many of our vegetables and other plants. Previous investigators[2,3,4,5] had described and named slightly different organisms which Leach endeavoured to show were either identical with or at most variants of *B. carotovorum*. This conclusion was based mainly upon four sets of observations recorded by himself or by others: (1) the similarity of the reactions in dextrose, sucrose and lactose; (2) the proved pathogenesis of authentic strains of *B. carotovorum* when inoculated into potato stems; (3) the isolation of this organism from a soft rotted tuber; (4) the blackening of "potato tissue killed by almost any organism" (Leach).

Lacey[6], however, had shown that the organism isolated from blackleg potato plants produced acid and gas in maltose, a sugar not used by Leach, whereas authentic strains of *B. carotovorum* did not, and furthermore, the latter when inoculated into potato stems produced a white pith rot, but never the characteristic blackening of the cortex caused by the former. Lacey considered these were sufficient reasons for retaining the original name of the organism, namely, *Bacillus phytophthorus* Appel. Bonde[7] has recently investigated the soft rots of the potato tuber in the United States and, following Leach, ascribes most of these to *B. carotovorum* (*Erwinia carotovora* of U.S. nomenclature). Like Leach, Bonde did not include maltose among the sugar reactions investigated but worked only with the same three used by Leach. In his tabulated results Bonde indicates that, while the organisms isolated from blackleg produced the characteristic blackening when inoculated into potato stems, some of those isolated from naturally rotted tubers did not.

During the past summer, I commenced a re-investigation of the disease, mainly with the object of trying to ascertain how it is propagated. From blackleg plants collected in various parts of Great Britain and sent to Cambridge for examination by the courtesy of the Ministry of Agriculture and Fisheries, an organism has been isolated which behaves in the manner described by Lacey, that is, produces acid and gas in maltose and the characteristic blackening of the tissues when inoculated into stems of living potato plants. At the same time a soft-rotting organism isolated from carrots was used for comparative studies, the results of which confirm those of Lacey, as it produced only wilting upon inoculation and formed no acid in maltose. It seems certain, therefore, that the organism isolated from blackleg is not identical with what is generally accepted as *B. carotovorum*, in that the former differs in pathogenesis and in an important biochemical character.

The blackleg organism must, therefore, be given a special label, for while it is correct to state that it will reproduce the disease upon artificial inoculation and forms acid and gas in maltose, this is not true of *all* strains of *B. carotovorum*. It is considered that the differences are good specific characters and that the original specific name should be employed, modified to conform with the generic name Bacterium. Appel's original name was *Bacillus phytophthorus*, but the genus Bacillus can no longer be used for non-sporing rods (Resolution I(*e*) approved by the Second International Congress for Microbiology, London, 1936[8]), and I[9] have stated my reasons for using the generic name Bacterium for the soft-rotting bacteria which are closely allied to the colon-typhoid group and for which this generic name is employed by Topley and Wilson[10]. The name of the blackleg organism should therefore be *Bacterium phytophthorum* (Appel) n. comb.

To sum up, blackleg is caused by a specific organism, *B. phytophthorum*, which also produces a soft rot in potato tubers and other plant tissues. Another and distinct organism, *B. carotovorum*, produces a similar rot in tubers, etc., but not blackleg of potato stems. The former produces acid in maltose, the latter does not. Potato tubers found in a rotted condition may harbour one or both organisms.

W. J. DOWSON.

Botany School,
Cambridge.
Jan. 24.

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[1] Leach, *Phytopath.*, 20, 743 (1930).

[2] van Hall, Inaug. Diss. Univ. Amsterdam (1902).

[3] Appel, *Arb. biol. Abt. Land. u. Forstwirt.*, K. Gsndhtsamt., 3, 134 (1903).

[4] Harrison, *Centralbl. Bakt.* (II), 17, 34 (1907).

[5] Pethybridge and Murphy, *Proc. Roy. Irish Acad.*, Sect. 29B, 1 (1911).

[6] Lacey, *Ann. Appl. Biol.*, 13, 1 (1926).

[7] Bonde, *Phytopath.*, 29, 831 (1939).

[8] St. John-Brooks and Breed, *J. Bact.*, 33, 445 (1937).

[9] Dowson, *Centralbl. Bakt.* (II), 100, 177 (1939).

[10] Topley and Wilson, "Principles of Bacteriology and Immunity", 2nd ed., 515 (1936).

Listeria: Change of Name for a Genus of Bacteria

I HAVE been informed that at the Third International Congress for Microbiologists, held in New York City, September 2–9, 1939, it was reported to the Committee on Nomenclature that the name *Listerella*, which I proposed for a genus of bacteria in 1927, had already been given to a Mycetozoan by Jahn in 1906.

My proposed name therefore becomes a homonym, but as the genus has acquired some importance in both human and veterinary pathology and references to "Listerellosis" are becoming fairly common in literature, I think that a name as near to my original proposal as possible is desirable. I therefore propose *Listeria* as the name for the genus of bacteria as defined by me in Publication No. 20 of the South African Institute for Medical Research, "The Plague Problem in South Africa", by J. A. Mitchell, J. H. Harvey Pirie and A. Ingram (Whole vol. 3, p. 169).

J. H. HARVEY PIRIE.
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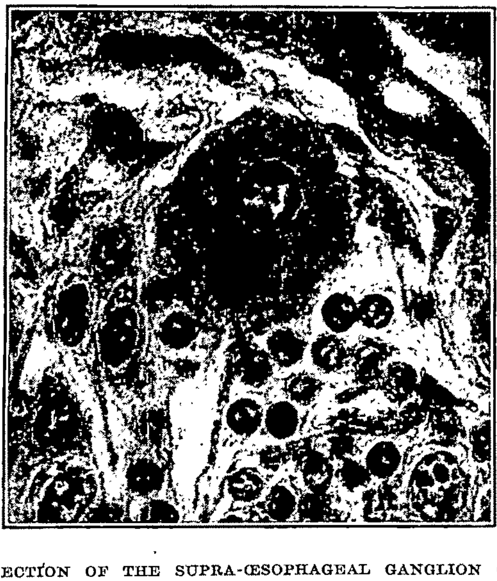
Johannesburg.
Jan. 16.

Neurosecretory Cells in the Ganglia of Lepidoptera

FOR many years the investigators of metamorphosis in the Lepidoptera have maintained that the source of the moulting hormone is the brain rather than the corpora allata, which Wigglesworth[1] formerly considered to be the organs producing the secretion in the bug, Rhodnius. Recently, however, Wigglesworth[2] has produced evidence which suggests that an area in the pars intercerebralis of the supra-œsophageal ganglion of Rhodnius is responsible for the production of the moulting hormone. As he points out, Hanström[3] had already described modified nerve cells in this same region which are considered, on morphological grounds, to be probably secretory in function. Neurosecretory cells have been described in several other insects, but it has been reported that, in spite of careful search, no such cells could be found in the brain of the moth larvæ (*Ephestia kuehniella*) studied by Schrader[4].



SECTION OF THE SUPRA-ŒSOPHAGEAL GANGLION OF THE MOTH *Eacles imperialis* DRU., SHOWING LARGE FUCHSINOPHIL CELL WHICH IS CONSIDERED TO BE SECRETORY IN FUNCTION. BOUIN FIXATION, GOLD IMPREGNATION FOLLOWED BY MALLORY'S TRIPLE. PHOTOMICROGRAPH × c. 700.

It seems of interest, therefore, to be able to report the discovery of cells very similar to those described by Hanström which I have found in the ganglia of certain Lepidoptera. They have been demonstrated in the pars intercerebralis of the supra-œsophageal ganglion of adult moths, in larvæ of all instars, and in pupæ. They have been found occasionally in the sub-œsophageal ganglia of larvæ, and in certain of the abdominal ganglia, but not in all. These cells have essentially the same staining properties as those of Rhodnius, being apparently modified ganglion cells, from which they differ in containing a granular cytoplasm or a number of droplets which are intensely fuchsinophil. They are well differentiated by Mallory's Triple strain.

They have been most studied in the larvæ of the moth *Ceratomia catalpæ* Bdv. (Sphingidæ), in which they are generally scattered singly, but may be grouped as those of Rhodnius. Although they may vary in number and in their exact position from larva to larva, no indication has been found of a cyclical production of secretion.

Similar cells have been found in the brains of several species of Heterocera belonging to the families Citheroniidæ, Phycitidæ, and Saturniidæ.

In view of the above-mentioned experimental evidence, it seems possible that these cells are the source of the moulting hormone in the moths, but the fact that similar cells can be demonstrated in some abdominal ganglia indicates that further experimental work must be done before a function can definitely be assigned to them. However, the similarity in staining properties of the cells from the brain and the abdominal ganglia does not, of course, necessarily indicate identity of function.

M. F. DAY.
Biological Laboratories,
Harvard University,
Cambridge, Mass.
Dec. 21.

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[1] Wigglesworth, V. B., *Quart. J. Micr. Sci.*, **77**, 191 (1934).
[2] Wigglesworth, V. B., NATURE, **144**, 753 (1939).
[3] Hanström, B., *Lunds Univ. Arsskrift*, N.F., **34**, No. 16 (1938).
[4] Schrader, K., *Biol. Zbl.*, **58**, 52 (1938).

Zoological Nomenclature

PROPOSAL of a 'stereotyped' zoological nomenclature almost invariably comes from a non-systematist or from a systematist working sporadically on a restricted group in a field where there is but a small literature and few workers. Any active worker in a large and progressive systematic field would realize at once that any 'stereotyping' plan is impossible. In my own subject, ichthyology, there is no general world monograph suitable for 'stereotyping' subsequent to Günther's "Catalogue" (1859–1870), and Günther's classification and nomenclature are now so out of date that no ichthyologist would accept it. There are a number of large faunal works of more recent date, but if they were 'stereotyped' for particular regions, their nomenclatural differences would force the wide utilization of different generic or specific names in different regions for identical genera or species. The vast number of forms thus affected would preclude any sensible arbitration of the conflicts. Not long ago one eminent anatomist proposed that the vagaries of elasmobranch nomenclature be settled by a return to the 1838 nomenclature of Müller and Henle's "Plagiostomen". But he did not suggest what was to be done with the numerous genera and species described since that time and with the various subsequent segregates of Müller and Henle's genera. As a matter of fact, return to this nomenclature of 1838 would necessitate the change of more valid names than were contained in the whole of Müller and Henle's work!

Those systematists who sincerely study zoological nomenclature in an effort to find a way of avoiding vexatious changes usually reach the conclusion that Linnean binomial nomenclature will never be entirely stable, since it is firmly wedded to classification and no one can prevent ideas of classification from changing so long as systematic research is carried on. If absolute stability is imperative, we must cast the entire Linnean system overboard. In my opinion, this will never be done.

As a matter of fact, the particular situation which has troubled Prof. Garstang[1] and Dr. Crossland[2] is not due to the Rules, but to what I consider misuse of the Rules by a small group of Australian nomenclaturists. The nomenclatural *tour de force* to which this group has treated conchology, ornithology, ichthyology, and other fields is deplored by most of the systematists of Europe, America and especially Australia. I am familiar only with the ichthyological side, but in regard to this I can say that comparatively few of these Australian innovations hold water systematically, and many are directly contrary to the Rules. Very likely Prof. Garstang's strictures, if applied to British nudibranchs *in conjunction with full knowledge and correct interpretation of the International Rules*, would restore at least some of the old nomenclature.

I say, at least some. A blind condemnation based purely on personal nomenclatural prejudice is unworthy of consideration in view of the long labours of the many persons who have built up the present International Rules in an attempt to evolve some universal basis for the greatest possible nomenclatural stability in all animal groups. Some general system of rules is imperative, and we have such a system. A great many of the cataclysmic nomenclatural revolutions that occur now and then in restricted groups are due to the utterly irresponsible and capricious nomenclatural practices of past workers. When at last a new and more able generation of workers, cognizant of the importance of adopting a universally acceptable nomenclature, appears, old names by the dozens are likely to fall and older workers to protest bitterly. The latter sometimes fail to realize that they are possibly at fault, or that their particular nook might perhaps need some change in order to make way for a more universal practice.

The present International Rules are not perfect. They have been arrived at only through an enormous amount of work and compromise. How great that work has been, and how difficult it is to obtain agreement on sensible amendments and to prevent the enactment of senseless ones, at the International Zoological Congresses, is largely unknown except to those who have studied the history of the Rules or who have actually been present at the nomenclatural sessions. Some idea of the complexity of points of view that had to be compromised may be gained by reading Dr. Stejneger's paper, "A Chapter in the History of Zoological Nomenclature"[3], and I recommend it to anyone wishing to amend the Rules. But certain improvements might be made without any change in the Rules. Nearly every systematist with whom I have discussed the matter has agreed that the creation of a number of sub-commissions for various animal groups, whose decisions should be subject to reversal only by the main International Commission, would speed up nomenclatural decisions enormously and remove any present causes for dissatisfaction. With several of my colleagues, I hope to present a plan of this sort formally in the near future.

George S. Myers.

Stanford University,
California.
Jan. 10.

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[1] Nature, 144, 481 (1939).

[2] Nature, 144, 942 (1939).

[3] *Smithsonian Misc. Coll.*, 77, No. 1.

Barkhausen-Kurz Oscillations with Positive Ions

Kownacki and Ratcliffe[1] have previously described an experimental method of investigating electron inertia effects in thermionic vacuum tubes. By replacing the electrons in a triode by positive ions of cæsium, of mass 25×10^4 times greater, they were able to slow down the effective transit times involved by a factor of about 500. In this way they demonstrated the occurrence of rectification effects, dependent upon a resonant transit time, at a wave-length of about 500 metres.

We have now found that it is possible to maintain oscillations of the Barkhausen-Kurz type by using positive ions emanating from a filament. A cylindrical electrode valve of the Type *AT* 40 had some cæsium inserted, and was kept at a temperature of about 30–70° C. with an accelerating potential of the order of 200 volts on the grid and with the anode at zero potential, or at a slightly retarding potential. Under certain conditions of positive ion current, determined by bulb temperature, the valve was found to maintain oscillations with a wave-length of the order of 500 m., corresponding to the time of transit of ions between the electrodes. We satisfied ourselves that the triode alone, with no external circuit tuned to a wave-length greater than about 50 cm. (the natural wave-length of the wire leads), would maintain an oscillation with a wave-length of about 500 m., and the wave-length depended on the electrode potentials employed. The addition of an external tuned circuit greatly increased the amplitude of the oscillation, but had only a second order effect on the frequency. There seems no doubt that the frequency of the oscillations was determined inside the valve itself. Oscillations of this type have often been called true Barkhausen-Kurz oscillations, in contrast to Gill-Morrell oscillations, the frequency of which is mainly determined by an external circuit.

This is not the place to describe our results in detail, but they may be summarized by saying that, at zero D.C. plate potential and with the minimum space current required for oscillation maintenance, the oscillation gave a pure heterodyne note corresponding to a single oscillation with a period approximately equal to one half the time T of ion transit from filament to plate and back, as given by the Scheibe expression[2]:

$$T = 4r_g \left\{ f\left(\sqrt{\log_e \frac{r_g}{r_f}}\right) + g\left(\sqrt{\log_e \frac{r_p}{r_g}}\right) \right\} \Big/ \sqrt{\frac{2eV_g}{M}}$$

Here T is the transit time in seconds, r_f, r_g and r_p are the radii of the filament, grid and plate respectively, V_g is the grid potential in E.M.U., e/M is the specific ionic charge in E.M.U./gm., and f, g are functions given in Scheibe's paper[2]. "Resonance rectification" effects were observed at periods of about T, $T/2$ and $T/3$.

As the space current was increased, the period of the oscillation became increasingly smaller than $T/2$. At a critical space current the type of oscillation suddenly changed, and the single oscillation was replaced by a set of oscillations of slightly different frequencies, which gave an impure heterodyne note. With further increased current the frequencies of the multiple oscillations diverged, and when the condition of space-charge-limited emission was approached, there was an abrupt change to a single oscillation period of rather less than T.

It appears that much information concerning the mechanism of electronic oscillations might be obtained by applying this method of investigation to valves with different electrode structures, and preferably to valves with structures which can be altered without opening up the tube.

W. S. ELLIOTT.
J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
Jan. 22.

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[1] NATURE, 141, 1009 (1938).

[2] Scheibe, *Ann. Phys.*, 73, 70 (1924).

Optical Anisotropy of Cellulose Sheet

THE birefringence[1] of 'Cellophane' (regenerated cellulose sheet) has been measured for more than two hundred samples, kindly supplied by the makers. Three main points have emerged:

(1) The birefringence (B) varies with the wavelength of the light used, the law being approximately

$$B = B_0\ (1 - 0{\cdot}000016\ \lambda),$$

where λ is in angstroms.

(2) Results for the birefringence of the thinnest material (about one thousandth of an inch) vary from 0·0056 to 0·0132, with a concentration around 0·0089. The thicker materials (1·2 and 1·6 thousandths of an inch) give, on the average, lower values of birefringence.

(3) The birefringence is least in the middle of the web, and is about 30 per cent greater near the selvedges.

ROBERT C. GRAY.

Department of Applied Physics,
University,
Glasgow.
Jan. 26.

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[1] Drummond, D. G., NATURE, 145, 67 (1940).

Kornerupine from Ceylon: a New Occurrence

SOME years ago we discovered specimens of kornerupine in mixed parcels of typical cut Ceylon gem-stones, and this prompted us to search for the mineral in gem gravel concentrates kindly sent to us direct from Ceylon by Mr. Hans Van Starrex. From the first lot of rough so examined, which consisted mostly of green zircons, two small pieces of kornerupine were recovered, so that yet another species must be added to the already long list of gem minerals found in the Ceylon gravels.

These two specimens, greenish-brown in colour and weighing 0·430 gm. and 0·436 gm. respectively, have the following properties: density, 3·33; refractive indexes, α 1·671, β 1·683, γ 1·684; $2V$, 25°, $r < v$; α light brown, β yellow, γ dark green. It may be noted that Madagascan kornerupine differs in having r greater than v.

Credit for the identification of our specimens is due to Dr. L. J. Spencer, and confirmation was provided by Dr. G. F. Claringbull, who kindly carried out X-ray measurements.

It is hoped that later a fuller account, together with a complete analysis, will be published in the *Mineralogical Magazine*.

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Jan. 26.

Blue Rocksalt

SPECIMENS of natural rocksalt are frequently coloured, the more usual colours being blue, violet and pink. Blue halite from Stassfurt in particular has received much attention, and many suggestions have been offered to account for the tint. Siedentopf's[1] theory that the colour is due to colloidal sodium was regarded generally as satisfactory until Spezia[2] pointed out that its solution should then be more alkaline than that of the colourless form—which it is not. Doelter[3] regards the colour as caused by foreign inclusions, colloidal or otherwise, and favours a mixture of iron and manganese, though sulphur and organic substances are not ruled out.

More recently, however, Kennard, Howell and Yaeckel[4] have decided against any pigmental theory, as the result of a spectroscopic examination of a specimen of colourless Stassfurt rocksalt containing a distinct zone of blue. No difference in composition between the coloured and colourless parts could be detected; traces of several foreign elements, including aluminium, lithium, silicon and titanium, were present in both. The authors regard their results as supporting the views of those earlier investigators[5] who have attributed the colour to some structural cause.

Apparently, however, gold has not been specially looked for; it may easily escape detection spectroscopically because it is not one of the very sensitive elements, some 10 p.p.m. being the lower limit of detection by ordinary methods. The *Glimmschicht* procedure, developed by Goldschmidt and his co-workers, is claimed to be some fifty times more sensitive[6], but does not appear to have come as yet into general use amongst mineralogists.

We have already shown[7] that sufficient gold is present in the blue and reddish-brown translucent celestines from Yate, Glos., to impart the observed colour if the metal is present in the colloid state. It occurred to us, therefore, that possibly blue Stassfurt halite might likewise contain colloidal gold. This appeared possible for two reasons. First, it is known that sea water frequently contains gold and if, during evaporation, this became concentrated locally, it might easily, if reduced to the colloid state, give rise to coloured streaks in the resulting rock salt. Experiment shows that, under favourable conditions, 1 to 4 p.p.m. of colloidal gold suffice to give a decided tint to a crystal although gold chloride would not, in general, be perceptible.

Secondly, Przibram[8] has noted the analogy between the blue tints of halite and anhydrite. Through the kindness of Mr. Arthur Russell, president of the Mineralogical Society, we have been able to examine a blue-tinted specimen of anhydrite from Cropwell Bishop, Notts., and find it to contain 4 p.p.m. of gold, amply sufficient to yield the observed tint.

Messrs. Gregory and Bottley generously gave us some deep blue Stassfurt halite and in it we found an average of 23 p.p.m. of gold, using an *o*-di-anisidine method[9]. This was again amply sufficient to impart the observed colour. We have found gold to be present also in specimens of both blue and pink halite from other localities, including Hallstadt and Wieliczka (Cracow).

Though we hesitate to draw definite conclusions from a mere half dozen analyses, we do venture to suggest, as worthy of consideration, the view that the colour of halite may, in certain cases at any rate, be connected with its gold content.

J. NEWTON FRIEND.
JOHN P. ALLCHIN.

Technical College,
Birmingham.
Jan. 27.

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[1] Siedentopf, *Phys. Z.*, 6, 855 (1905).

[2] Spezia, *Zentr. Min.*, 398 (1909).

[3] Doelter, *Monatsh.*, **52**, 241 (1929).

[4] Kennard, and others, *Amer. Min.*, **22**, 65 (1937).

[5] Notably Przibram, Guthrie, Phipps and Brode.

[6] See "Spectrum Analysis" by Strock (Hilger, 1936).

[7] Friend and Allchin, NATURE, **144**, 633 (1939).

[8] Przibram, *Chem. Zentr.*, 2, 753 (1936).

[9] Based on Pollard, *Analyst*, **62**, 597 (1937), and Jamieson and Watson *ibid.*, **63**, 702 (1938).

Points from Foregoing Letters

W. C. O. Hill shows that differences within the family Hominidæ are of three orders—generic, specific and subspecific. Brief specifications of the status of these are given, but it is pointed out that the members of the family are particularly liable to interspecific and intersubspecific hybridism. Nevertheless, a plea for the observance of the same rules of nomenclature as employed by zoologists is made, and an effort thus made to remove some of the confusion at present existing in anthropological literature. The misuse of the term 'race' and the irregular usage of the title *Homo sapiens* are particularly to be regretted.

Although coprophagy has recently been shown to be a normal physiological process in the laboratory rabbit, there are apparently no previous records of it occurring in the wild. Observations by H. N. Southern of a wild population have shown several instances of refection, and the process is probably important in enabling wild rabbits to tide over unfavourable periods, when food supply is short, or when they are kept in their burrows by persecution.

The slightly differing bacteria causing potato blackleg, the first of which was called *Bacillus phytophthorus*, are now considered to be identical with *Bacterium carotovorum*. One organism isolated from blackleg, however, forms acid in maltose and reproduces the characteristic symptoms of the disease upon inoculation, whereas authentic strains of *B. carotovorum* do not. These differences are considered by W. J. Dowson to be sound specific characters, and necessitate a separate name for this blackleg pathogen. As *Bacillus* can no longer be used, the correct name should be *Bacterium phytophthorum*. Both organisms may occur in naturally rotted tubers.

M. F. Day describes modified nerve cells from the ganglia of several species of moths, and suggests that these may be the source of the moulting hormone in these insects.

G. S. Myers discusses the difficulties of rigid application of the International Rules of Zoological Nomenclature. In order to hasten the procedure, he suggests the formation of sub-commissions for various animal groups, the decisions of which would be subject to reversal only by the International Commission itself.

'Barkhausen-Kurz' oscillations have been obtained by W. S. Elliott and J. A. Ratcliffe at a wave-length of 500 m. by the use of heavy positive ions in place of electrons in a cylindrical triode. The production of oscillations did not require the presence of any tuned external circuit, and the frequency was determined solely by the operating conditions of the triode. The Scheibe transit time formula was obeyed in the case of weak oscillations. Various types of oscillation have been found for different operating conditions.

The birefringence of regenerated cellulose sheet is found by R. C. Gray to decrease slightly with increasing wave-length, to vary within wide limits about a mean value of about 0·0089, and to be, at the selvedges of the web, about 30 per cent greater than at the middle of the web.

Small pieces of the rare mineral kornerupine have been recovered from samples of Ceylon gem gravel, an occurrence not hitherto reported. Optical data for these specimens are given by B. W. Anderson and C. J. Payne.

Blue Stassfurt halite has been found by J. N. Friend and J. P. Allchin to contain gold which, if in colloidal condition, would be ample to cause the observed colour. It is suggested that the colours of various rocksalts may be connected with their gold contents.

RESEARCH ITEMS

Coloured Families in Liverpool

AN investigation undertaken under the auspices of the Liverpool Association for the Welfare of Coloured People into the economic status of 225 coloured families, supplements an investigation made some ten years ago, while reflecting changes in conditions which have taken place in that period ("The Economic Status of Coloured Families in the Port of Liverpool". The University Press of Liverpool, 1939. Pp. 23. 1*s*. net). The investigation was organized and directed by D. Caradog Jones, the material collected and analysed by Kathleen Johnstone of the Department of Social Science in the University of Liverpool. The coloured families investigated belonged to the class of those who had made "domicile of choice", and were known to have been insured under the Unemployment Insurance Acts. The bulk, but not all, of the men were West African in origin. Only one had been in the country for less than five years, while the largest proportion, 100, had been here for more than twenty and less than thirty years. The investigation in the main was confined to householders. Of the families visited, 201 had a married man as head, 2 with a widower, 3 with a single man, and 19 with a widow as head. Of the 206 male heads, 4 were old age pensioners or invalids; of the remainder 149 were unemployed. There are relatively few of pensionable age. There is a high proportion between 45 and 65, with a low proportion between 21 and 45 years. The mean number of children per family is 2·6 as compared with white 4·8. During the last ten years a change for the worse in economic conditions has taken place. Of coloured only 40 per cent were in receipt of earnings as contrasted with 75 of a survey sample of white seamen, while 73 per cent of the coloured were in receipt of unemployment benefit as against 34 per cent white. In relation to the poverty line, the figures are as follow: more than 50 per cent above, coloured 14·4, white 48·5; within 10 per cent above or below, coloured 22·3, white 10·0; and 10 per cent to 33 per cent below, coloured 20·4, white 15·4.

Marriage Customs among the Barolong, South Africa

THE Barolong belong to the western cluster of the Sotho group of the Bantu-speaking tribes of South Africa and are found mainly in British Bechuanaland. Their marriage customs have been studied by Z. K. Matthews on information collected in the course of two visits in 1935 and 1937 (*Africa*, 13, 1; 1940). Socially the Barolong are divided into four sections, named after sons of a former chief who died about 1760. A number of agencies of acculturation, especially missionary influence and administration, have been at work among them. Traditional forms of social grouping based on kinship, locality, age, occupation and rank persist among them, but are undergoing much change. The traditional marriage customs of the Tshidi Barolong attach a great deal of importance to the institution, which is regarded as a state which should not be lightly entered upon, not only in the interests of the individual, but also of their kinship groups, including both the living and the dead, as well as the welfare of the tribe in which they live. It is a sacred duty to one's family to marry in order to continue the line of descent. Much litigation is concerned with family law, and constantly directs the attention of members of the tribe to the importance of the institution of marriage. Marriage is also regarded as a means of cementing friendship between two groups. It is therefore not surprising to find that parents claim and exercise the right to control the marriages of their children, especially when it is a matter of the chief wife, whose children receive first preference in the matter of succession to property. The term 'parents' includes other kinsmen who have the right to advise, especially father's father and brothers and important paternal kinsmen, while the views of the maternal relatives must be taken into account, especially those of the mother's brother, as no serious step can be taken in the affairs of her sister's children unless he be consulted. It must not be taken, however, that the wishes of the man or woman about to be married will be entirely ignored, or that an individual could be compelled to marry against his or her wishes.

Nitrogen Excretion and Metamorphosis

THE generalization that ammonia, urea and uric acid excretion are characteristic of aquatic, amphibian and terrestrial life respectively has received support by the work of A. F. Munroe (*Biochem. J.*, 33, 1957; 1939). He finds that a rapid change-over from ammonia to urea excretion occurs in the tadpole during the metamorphic stage of development, and this is also accompanied by a large increase in liver arginase. The initiation of the change is coincident with the period when the gills are shrivelling and the forelimbs are just piercing the gill coverings and thus giving rise to a functionally active terrestrial animal. He considers that liberation of thyroid substance, the stimulus for metamorphic change, exerts a direct effect on nitrogen metabolism in the liver, and he intends to continue the experiments on axolotls fed with thyroid.

Wing Dimorphism in a Dipterous Insect

JEAN GUIBÉ has published a detailed study of the growth and biology of the fly *Apterina pedestris* Meig., belonging to the family Sphæroceridæ or Borboridæ (*Suppléments* (No. 26) au *Bulletin Biologique de France et de la Belgique*). The most important part of this memoir concerns his breeding experiments. The only known wild type of the insect is the micropterous form, which is widely distributed in the northern Palæarctic region. Three types have been bred out, and it is shown that their inheritance is along simple Mendelian lines. One type, the homozygous micropterous form, produces, *inter se*, its own and no other form. The heterozygous micropterous type produces its own and a macropterous type in approximately the proportion of 3 : 1; in one breeding experiment the progeny resulted in exactly that proportion, namely, 555 micropterous individuals and 185 of the macropterous kind. By crossing heterozygous micropterous forms with macropterous forms, almost equal numbers of both resulted in the progeny. It is evident that micropterism is dominant and that macropterism is recessive. The author concludes that macropterism corresponds to a simple Mendelian mutation, but this idea seems contrary to Dollo's law, since it implies re-acquisition of the former fully winged state. Few biologists will dispute that the original ancestors were fully winged or macropterous at an earlier stage in evolution. It would, therefore, seem reasonable to dissent from the author and interpret the micropterous form as the mutant and the long-winged form as the persistent original type. A further point of great interest is displayed in the author's account of the morphological differences in the wings and venation of the homozygous and heterozygous short-winged forms.

The Genus Streptocarpus

W. J. C. LAWRENCE has reviewed the origins and horticultural development of the genus Streptocarpus in a recent paper (*J. Roy. Hort. Soc.*, **65**, Pt. 1; January 1940). Plants of this group, though now florally valuable in many parts of the world, have been introduced to cultivation from South Africa, where they are concentrated on the Drakensberg Mountains. Stemless species which comprise the section Eu-Streptocarpus vary from the single-leaved forms, which are found mainly in the north, to the rosette kinds, which occur most commonly in the south. Intermediate forms appear in the middle of the Drakensberg range, and since all species of Streptocarpus have the same number of chromosomes, and many readily hybridize, it would seem that they are variants from some common stock. Mr. Lawrence then shows the effect of this variation upon the production of the beautiful garden hybrids now extant. A tetraploid form of a hybrid with *S. grandis* has occurred and has been named 'Merton Giant'. This geographical and genetical analysis of species in the making is a constructive replacement of the tendency to name each inconstant variable, so often favoured by the taxonomic 'splitter'.

Cirque Formation

THE *Bergschrund* hypothesis of cirque formation by a process of basal sapping of the rock has been more or less accepted in one form or another since it was suggested by W. D. Johnson. In recent years, however, W. V. Lewis has stressed the importance of meltwater in cirque formation, and he returns to this subject in an article in the *Geographical Review* of January. The evidence is obtained from cirques in Iceland, Spitsbergen and Switzerland. That meltwater occurs below the level of the *Bergschrund* and melts its way under the glacier seems to be established, but unless this water can refreeze it can have no plucking action on the rock wall. Various observations have shown that low winter temperatures do not penetrate very deep in glaciers, but in the want of contrary evidence Mr. Lewis suggests that freeze–thaw processes do take place at depths below the deepest *Bergschrund*. He points out that no temperatures have yet been taken at the head wall under a glacier, and that only a small amount of the meltwater need freeze in order to affect the rock wall, and finally that at great depths the temperatures must be fractionally below freezing point or the ice would melt under the pressure to which it is subjected. The weight of 36 feet of ice is equivalent to one atmosphere, so that the temperature within a glacier must fall at least at the rate of 0·1° C. for every 500 feet in order that the glacier may exist. If local melting due to descending water releases the pressure at a point beneath a glacier, then the meltwater will rapidly fall in temperature, being chilled by the ice, and rapidly freeze. On re-application of the pressure any ice at 0° C. will melt again. Thus an alternation of freeze and thaw is possible.

Structure of the Pacific Basin

ACCORDING to B. Gutenberg (*Science*, **90**, 456–458; Nov. 17, 1939) the movements along the San Andreas fault in California occur in such a way that the eastern (continental) side moves south-eastward relative to the western (Pacific) side. Ch. Tsuboi has also stated that in Japan, along all faults, without exception the continental (western) side is moving southward relative to the Pacific side. In addition, Bailey Willis contends that movements along the major fault in the Philippines occur in the same way, the continental side moving southward relative to the Pacific side. Gutenberg further states that the definite compression-dilatational patterns observed in all earthquakes without regard to their focal depth indicate that in all shocks the processes producing the waves are of the same type of faulting or shearing and cannot be due to a pure explosion or collapse in the interior of the earth. Great earthquakes are common around the Pacific, and all deep focus earthquakes so far accurately determined have originated in the circum-Pacific area. The boundary of the true Pacific basin is outlined by the earthquake epicentres. On the west side it follows the 'Andesite' line, which separates regions of different petrological and chemical composition. The foci of all earthquakes originating deeper than 200 miles have been found close to, and on the continental side of, this boundary. Different types of seismological evidence concur that continental surface layers appear to be missing over the greater part of the Pacific basin, but they are present in small thicknesses near Japan, New Zealand and California. There is also an area with 'continental' structure in the south-eastern part of the Pacific basin, though partially the Arctic basin appears to be of Pacific type.

Nuclear Isomerism in Zinc

IN the radioactive zinc obtained by bombarding zinc with deuterons, two β-emitters of half-lives about 57 min. and 14 hr. have been assigned to the isotope ^{69}Zn, which is therefore a case of nuclear isomerism. J. W. Kennedy, G. T. Seaborg and E. Segrè (*Phys. Rev.*, **56**, 1095) have now shown that the absorption properties of the β-rays from these two activities are the same. The β-spectra are presumably identical, and it is suggested that in each case the β-rays come from the 57-min. product, while the 14-hr. ^{69}Zn is a metastable excited state of the nucleus which decays to 57-min. ^{69}Zn with emission of a γ-ray. The γ-rays of energy 0·47 Mev. should therefore have no correspondence in time with the β-rays. This was verified by a coincidence counter arrangement which in a check experiment successfully detected the coincidences between the β- and γ-rays of thorium B. An attempt to separate the isomers chemically by taking advantage of the γ-ray recoil of the 57-min. product gave no positive result.

PROBLEMS OF EVACUATION

ASPECTS of evacuation problems are discussed in recent articles in the *Political Quarterly* and the *Quarterly Review*, which make a number of useful suggestions for their solution. Reviewing the working and present position of the evacuation scheme in the *Political Quarterly*, Mr. A. D. K. Owen suggests that in Scotland uncertainty concerning the financial aspects of evacuation played a considerable part in deterring many people from going away or permitting their children to leave vulnerable areas. He considers that more effective publicity, directed to the poorer sections of the population, relating to the financial implications of evacuation might have resulted in a more satisfactory response.

While in the reception areas the situation is in many ways not unsatisfactory, it is difficult to see how the evacuation scheme can be successfully rebuilt in the absence of compulsory powers. Mr. Owen suggests that certain districts within the existing evacuation areas should be scheduled as specially dangerous—all places, for example, within a certain distance of military or naval targets, shipbuilding yards, docks or important railway junctions—and children of school age prohibited from living in them save in very exceptional circumstances. He also suggests that the law of school attendance should be amended so as to prevent parents from bringing their children home from reception areas without good reasons.

The first measure would involve transferring all schools serving the prohibited districts to reception areas, and the second would make it possible to plan ahead with some assurance that the population for which plans are being made would not melt away before they matured. Schools in those parts of the evacuation areas which lie outside the prohibited districts should be opened as soon as they have been given reasonable protection, but a fresh approach made to parents in these areas to persuade them to allow their children to be evacuated or re-evacuated.

Capt. Frederic Evans, in the *Quarterly Review*, directs attention rather to measures which might be taken in the reception areas to organize new life for evacuees within the strange environment to which they have been taken. He emphasizes the importance of balancing out school accommodation and staffs, the development of specialized accommodation for difficult children, clinics, recreation and other purposes. Holiday camps, youth hostels, and village halls could all offer important contributions, and if well organized might contribute to a closer wedding of the town to the country, with far-reaching and beneficial consequences to the whole nation.

Psychological and financial problems have to be faced and the careful planning of the medical services in the country is of special importance. Their staffing and provision pre-suppose a national service. Capt. Evans urges that the considerable expenditure involved in the various social services required to solve these problems must be incurred or we may find the War has been fought in vain.

Dr. W. A. Robson's article, "Evacuation, Town Planning and the War", is concerned with the wide issues which are opened up by the evacuation not merely of school children, but also of civil servants, business houses, etc., and the imperative need for some central control and planning if chaos is not to result from the indiscriminate location not merely of industry in the reception areas but also from the tremendous demand for premises and land by the civil and military authorities. The demands of the War Office and the Air Ministry for camps and aerodromes must be met without question or delay; but it would be the gravest mistake to permit all these new and necessary constructions arising from these as well as from civil needs, and also the consequences of evacuation, to take place in utter confusion or on the basis of *laissez-faire*, and with a complete disregard of the peace-time situation which will follow the War.

For this reason, and because our war-time exigencies are strangely consistent with socially desirable peace-time purposes, Dr. Robson views with such alarm the abandonment by the Government of the reports of the Royal Commission on the geographical distribution of the industrial population. Town and country planning should now acquire a new and more important status and be placed in the hands of a strong central department competent not only to deal with the special needs of the Service departments and the Government offices, but also to take over the long overdue task of directing the location of industry and formulating a national plan for the whole country.

AIR CONDITIONING

AN abstract of a paper on "Air Conditioning" read by W. Chambers to the North Midland Section of the Students of the Institution of Electrical Engineers and published in the Institution's *Journal* of December gives a clear account of the objects to be attained by air-conditioning and of the methods by which it can be done.

The object is to maintain in a building an atmosphere that is most beneficial to the health of the occupants or which is most suitable to the process of manufacture carried on therein. To maintain these conditions, it is necessary to control the heat content or temperature, the purity, the moisture content (humidity) and the distribution of the air. A ventilating scheme in which the air is filtered, comfortable in temperature and adequate in volume, is sometimes considered entirely satisfactory, and little if any attention is paid to its moisture content, although the latter has a great effect upon the comfort of the human body.

In the case of public buildings where the number of occupants may be large and the lighting load large in comparison with the human content, the heat and emanations produced by the occupants have to be counteracted. The atmosphere should have a normal natural temperature and moisture content, with sufficient movement of the air to overcome stagnation.

To raise the temperature of the air in winter, it is only necessary to pass it over a hot surface, and most air heaters therefore consist of finned tubes which are steam-heated, and over which the air is forced to pass by means of centrifugal type fans. It must be remembered that heating lowers the relative humidity, owing to the fact that heated air is contained in a larger volume, but it still carries the same initial quantity of moisture as before heating took place. A pre-heated spray washer to maintain the humidity under control is often used.

In summer, in cooling the air the reverse applies, the relative humidity being increased, so that drying is necessary. This is done by exposing the air to cold surfaces or cold spray, whereby excess moisture is condensed and the air left saturated at a lower temperature. This can be done by mixing the air with air which has not been cooled.

In industrial neighbourhoods, it is necessary to extract from the air dust and grime particles. For this purpose filters are used, and the entire volume of air to be circulated is passed through them. Washers, viscous-type filters and throw-away type filters are used. The last type consists of a cheap fabric which may be cleaned by a vacuum cleaner nozzle, but it is more usual to dispense with them entirely and replace by new fabric. The efficiency of these filters is claimed to be greater than 99 per cent with removal of particles down to 1/30,000 in.

The comfort chart which the American Society of Heating and Ventilating Engineers has evolved shows that summer and winter conditions vary and that the average conditions are a temperature of 72° F. with a relative humidity of 50–60 per cent for summer and a temperature of 66° for winter with a similar humidity.

In an actual installation, the air is first passed through a filter and then tempered in a preheater; this has the effect of preventing the incoming air from being too cold and freezing the water in the washer. The science of air-conditioning is making great progress. The engineer of the future who aims at a thorough mastery of his subject must know physics, especially thermodynamics, and have also some knowledge of those branches of chemistry, medicine, biology, psychology and physiology connected with it.

ORIGIN OF THE CORPUS CALLOSUM

IN "Man's Place in Nature", T. H. Huxley expressed some astonishment at the abrupt appearance of a corpus callosum in placental mammals, suggesting that this phenomenon represents "the greatest leap anywhere made by Nature in her brainwork". Later on, between 1887 and 1895, this problem was studied by a number of anatomists, including Osborn, Zuckerkandl, Symington, Herrick and Elliot Smith, and several divergent opinions were expressed as to the phylogenetic origin of the commissure.

The evidence was clarified to a very considerable extent by the detailed work of Elliot Smith, who made full use of his opportunities in Australia for studying the comparative anatomy of monotreme and marsupial brains. Elliot Smith believed the corpus callosum to be a neomorph which is characteristic of eutherian mammals, and he suggested that its development was facilitated by the bilaminar formation of the fornix commissure which is developed in the marsupial brain. This observation also led him to infer the probability of a metatherian ancestry for placental mammals. Elliot Smith further directed attention to the distorting effect of the corpus callosum on the hippocampal formation, whereby the latter becomes stretched out into a thin atrophic layer of grey matter—the indusium. The latter, again, becomes continuous anteriorly with the hippocampal rudiment found in the precommissural area of the cerebral hemisphere. All these observations, and the conclusions whch are to be drawn from them, have been accepted for many years by most comparative neurologists.

Quite recently, however, the whole question has been raised afresh by the contention of an Australian anatomist—Dr. A. A. Abbie[1]—that in its development the corpus callosum does not, after all, make use of a previous pathway already established by the fibres of the dorsal lamina of the fornix commissure, but is an entirely new commissural connexion formed along a zone of fusion between the two cerebral hemispheres which occurs *dorsal* to the hippocampus. According to Abbie's interpretation, the indusium is thus not the rudiment of the hippocampus at all, but a representative of an adjacent cortical area, the subiculum.

In a communication to NATURE[2] Abbie discussed the bearing of his conception of the origin of the corpus callosum on the ancestry of the Eutheria. It is interesting to note, however, that his conclusions do not differ essentially from those inferred by Elliot Smith on other grounds, for Abbie contends that the expansion of the neocortex and the consequent formation of a hippocampal fissure are the minimal requirements for the development of a corpus callosum, and this condition is first realized in the brain of monotremes and marsupials.

But it is important to note that Abbie's interpretation of the development of the corpus callosum has not passed unchallenged. In the current issue of the *Journal of Anatomy* another anatomist in Australia, Prof. F. Golby, has subjected the new thesis to a very critical examination[3]. His observations suggest that Abbie has been misled in his interpretation of microscopic sections by the distortion of the hippocampal formation at the subsplenial flexure, a distortion which has resulted in a reversal and displacement to a dorsal position of some of the fibres of the fornix commissure (forming the fornix superior), as well as in an illusory appearance in the position of the corpus callosum relative to the hippocampus. Moreover, Goldby reproduces what appears to be a very convincing photomicrograph of a sagittal section of the brain of a rat which illustrates the precommissural hippocampal rudiment extending *dorsally* to the genu of the corpus callosum to become directly continuous with the indusium. Other observations of Goldby on the brain of a bat, Eptesicus, in which the disturbing influence of a subsplenial flexure is absent, also indicate that (as Elliot Smith maintained in his classical studies) the corpus callosum of placental mammals really does lie morphologically ventral to the hippocampus or its vestiges.

It remains to be seen whether Dr. Abbie's theory will find acceptance with other comparative neurologists. It may be suggested, in any event, that it will require to be supported by embryological evidence before it is found to be acceptable.

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[1] "The Origin of the Corpus Callosum", *J. Comp. Neurol.*, **70**, 9 (1939).

[2] "The Ancestors of the Eutheria", NATURE, **144**, 523 (1939).

[3] "On the Relative Position of the Hippocampus and the Corpus Callosum in Placental Mammals". *J. Anat.*, **74**, 227 (1940).

A ROMAN TOWN IN EAST YORKSHIRE

THE completion of five seasons excavation in the Bozzes Field, at Brough, East Yorkshire, affords an opportunity for a summary of the results of the investigation. Although further excavation may necessitate modification of detail, it is considered that the examination of this Roman site has gone sufficiently far to secure the main outlines and conclusions as to its history which have been attempted by Mr. Philip Corder and Rev. Thomas Romans ("Excavations at the Roman Town at Brough, 1937", *Hull Museum Publications*, No. 206; 1939).

Although the site lies within the northern military area and is on a route that was of great strategic importance during the early wars against the Brigantes, its occupation throughout its history, except for a brief period in the first century, was of a civil character. The Parisii of the wolds, in whose territory it was situated, were village dwellers, and no hill-top fort or town is known in the part of Yorkshire which they inhabited. Petuaria, as it is now known the town was called, eventually became the tribal capital and a walled town with Romanized institutions, but in size it never exceeded twelve acres.

Little is known of the life of the Parisii before the Roman conquest, but a settlement has recently come to light at North Ferriby on the north bank of the Humber, placed conveniently on the pre-Roman route across the Humber and at the same time well situated for overseas trade with the Belgae of the Continent, for which evidence is afforded by Samian ware, *terra nigrea* and butt beakers found side by side with native vessels. Occupation, apparently, closes in the middle of the first century, at about the time of, or soon after, the establishment of the Ninth Legion at Lincoln in A.D. 47 and the construction of Ermine Street. North Ferriby was then abandoned and the inhabitants, moving about three miles up the river, founded Petuaria at the point where Ermine Street crosses the Humber.

The phases of occupation may be summarized in brief as follows: The original settlement, little more than a kraal of native huts, without defences or regular plan, was swept away and the sites of the huts levelled to make way for the first Roman town in the opening years of the second century. This town also was without defences. For a period after A.D. 71 a semi-permanent military base camp existed north of the settlement, which was abandoned after the construction of a great permanent fort farther north at Malton. In the reign of Trajan at the turn of the century grandiose plans were initiated for rebuilding the whole town in stone in Roman fashion. Massive foundations were laid and good roads made for the first time. These plans were never carried to completion.

The reason for the interruption, which appears also at Malton, is unknown. Early in the reign of Hadrian, building was resumed, attention being directed first to the defences, for which the earlier plan had made no provision. These defences are contemporary with Hadrian's Wall. The earliest buildings in stone within the town now appear, but their construction is poor and suggests haste. Thirty or forty years later much building activity is evident. In the reign of Antoninus Pius the defences, in which ramparts of turf had been employed, were entirely reconstructed in stone, a massive wall revetment being constructed in front of a rampart of red clay incorporating the earlier turf bank. The Antonine period marks the hey-day of Petuaria, and small though it was, it must have been a centre of Roman culture.

Throughout the third century town life in Britain declined, while large estates and farms flourished. Petuaria shared the general fate. No complete building can be ascribed to this century, though coins and pottery attest a continued occupation. It shared also, however, in the attempt to revive town life in the fourth century under Constantius Chlorus. The town walls received massive rectangular towers, 25 feet wide and 10 feet deep. Within the town old buildings were reconditioned and new ones constructed. The attempt to put new life into the town failed here as elsewhere and beyond a few minor alterations to existing structures no building within the town can be attributed to a later date than the beginning of the fourth century. The coin list dwindles and ends with single coins of Gratian and Magnus Maximus, while late fourth century pottery of the period of the coastal signal stations occurs only sparsely. It is impossible to resist the conclusion that the life of Petuaria had already shrunk to insignificance at the time when the farms of the wolds were still prosperous.

Evidence of the status of Petuaria is afforded by an inscribed stone set up in the reign of Antoninus Pius by M. Ulpius Januarius, *aedile* of the *vicus*, to commemorate work done at his own expense in connexion with a theatre. Normally the *vicus* was unimportant and the business of its council parochial. The existence of an *aedile* at Petuaria implies the dignity of a self-governing *civitas* with full jurisdiction over all the *vici* in its territory. This in conjunction with other evidence would go to show that Petuaria had now become the seat of cantonal authority.

MECHANISM OF DRUG ACTIVITY

"HOW DO DRUGS ACT ?" was the subject of an address delivered by Sir Walter Langdon-Brown to an evening meeting of the Pharmaceutical Society on February 13. He classified the principal ways in which drugs act thus: (1) they increase or diminish the effects of stimuli reaching the cell from without; (2) they modify the chemical changes occurring within the cell itself; (3) they may themselves be so altered in chemical constitution by the cell as to be capable of fresh activity, yet with diminished toxicity. He illustrated each of these methods by examples, some of the best illustrations of the first group from hormones, of the second from vitamins, and of the third from chemotherapy.

It was little realized at the beginning of this century that a new era had dawned when Langley showed that the effect of adrenaline on any part was the same as if the sympathetic nerve to it had been stimulated; it merely seemed an interesting example of a chemical substance imitating a nervous stimulus. But it was much more important than that; although adrenaline has no effect on a structure which has never received a sympathetic innervation, Elliott found that cutting off that innervation did not abolish the effect of adrenaline on a structure which had once possessed it. On the contrary, its effect was actually increased. For this reason both Langley and Elliott independently put forward the theory of a receptive substance beyond the nerve ending, on which the drug acted. Sympathetic stimulation has been found to produce adrenaline at the nerve endings; this is in addition to the adrenaline always stored up in the medulla of the adrenal gland which can be drawn upon as an emergency ration when there is a sudden demand for widespread action of the sympathetic for purposes of defence. Other illustrations were given showing how the normal transmission of the nervous stimulus is effected and the ways in which it may be interfered with or assisted by certain drugs.

Sir Walter next gave some examples of the way in which drugs may act by modifying the chemical changes within the cell itself; he started by discussing some of the activities of thyroid extract, the quickening effect of which on metabolism has been described as the draught to a fire.

Other observations on drugs and oxidation processes were followed by extensive references to vitamin C (ascorbic acid), which is now so widely used as a drug. As a strong reducing agent, it acts by balancing oxidation and reduction changes in the cell. Much study, said Sir Walter, has been recently directed to vague ill-health, short of that necessary to induce scurvy, due to lack of vitamin C. He gave an example which showed clearly that a specific case of vague ill-health was due to dietetic deficiency, and the material ascorbic acid was ready to hand to re-establish healthy oxidation and reduction changes within the cell.

Chemotherapy illustrates the third group, the alteration of a drug by the cell so that it assumes fresh activity yet with diminished toxicity. Sir Walter said that the treatment of any malady with a chemical agent of known composition may be included, strictly speaking, in the term chemotherapy, although it is almost universally limited to the treatment of parasitic diseases by chemical disinfection or control of the causative agent without producing marked toxic effect on its patient. The specific effects of drugs such as emetine in amœbic dysentery and arsphenamine in syphilis depends upon their chemical interactions with some constituent of the living cell.

MILK AND NUTRITION

A FULL account of a large-scale trial of the effects of giving various milk supplements to children at school is given in the final report of the Milk Nutrition Committee ("Milk and Nutrition". Part 4. National Institute for Research in Dairying, Shinfield, Reading. 2*s*. post paid). The researches of the Committee have been undertaken to compare the nutritive values of raw and of pasteurized milk. In the present report, results are given of tests upon school children of the growth and health-promoting properties of supplements of ⅓ or ⅔ pint of milk—amounts the same as those which figure in the Milk-in-Schools Scheme of the Ministry of Health.

Some eight thousand children from five different areas were divided at random into four groups, to receive, over one year, a daily ration at school of (1) biscuits; (2) ⅓ pint of pasteurized milk; (3) ⅔ pint of pasteurized milk; and (4) ⅔ pint of raw milk. The children were periodically examined, measurements being made of their physique together with assessments of their state of nutrition, intellectual ability, and other features such as posture and complexion.

The general trend of the figures obtained, set out in a number of tables, shows that the children given milk supplements increased in height, chest-circumference, and strength of pull to a greater extent than those receiving biscuits, and also improved more in their general state of nutrition and in their teachers' assessment of their ability. In addition, those on the larger milk supplement usually showed an improvement above those on the smaller, while there was no consistent difference between those on similar supplements of raw and of pasteurized milk. The advantages accruing to the milk-drinkers compared with the biscuit-eaters were small, though uniform and significant, amounting to less than $\frac{1}{10}$ in. in height and ¼–1 lb. in weight over the whole year during which the experiment was in progress. There was, unfortunately, no means of control over the home diet, and it is therefore possible that some given biscuits may have received additional milk at home, while milk-drinkers may have had extra biscuits.

A summary of the previously reported results of laboratory experiments on animals and feeding trials on calves is also given in this report.

SEVENTY YEARS AGO

Nature, vol. 1, February 17, 1870

Measurement of Geological Time

The first of two articles by A. Russel Wallace on this subject appears. "Modern geological research has rendered it almost certain that the same causes which produced the various formations with their embedded fossils have continued to act down to the present day." This, Wallace points out, should make it possible to estimate the time represented by the whole series of formations, but the changes observed are too minute and too imperfect for such an estimate to be of value. The gaps in the record might be filled from observation of the changes of animal and plant life presented by each formation. "To measure geological time, therefore, all we require is a trustworthy unit for the change of species : but this is exactly what we have not yet been able to get ; for the whole length of the historical period has not produced the slightest perceptible change in any living thing in a state of nature."

Wallace then gives a summary of astronomical evidence on the subject, referring in considerable detail to Croll's calculation of the eccentricity of the earth's orbit and the precession of the equinoxes in relation to the production of climatic changes. "Mr. Croll considers astronomical causes to be the most important and effective agents in modifying climate while Sir Charles Lyell maintains that the distribution of land and water, with their action on each other by influencing marine and aerial currents, are of preponderating importance."

The Newall Telescope

"The 25-inch Equatorial Telescope, commenced several years ago by T. Cooke and Sons, of York, for R. S. Newall, Esq., of Gateshead, is now so far completed that it has been removed from the works at York into its observatory in Mr. Newall's grounds at Fern Deal. The completion of a telescope with an object glass of 25 inches aperture marks an epoch in astronomy, and its completion in England again places us in the front rank in the matter of the optical art."

The tube of the instrument was 32 ft. long, and cigar-shaped ; it was constructed of steel plates riveted together ; focal length of lens, 29 ft. A full-page wood-cut of the instrument was printed.

Professor Liebig disputes Pasteur's view that the decomposition of sugar in fermentation depends on the development and multiplication of yeast-cells and that fermentation generally is only a phenomenon accompanying the vital process of yeast. He expresses the opinion that Pasteur's researches have not explained fermentation ; but have only made known another phenomenon—the development of yeast—which equally requires explanation.

The *Lancet*, in speaking of the arrangements of hospitals, instances, as much needing reform, the system of grouping together indiscriminately in medical words, cases of various affections, in an atmosphere which may be destructive to some patients while it is suitable to others. Thus we may find lying side by side a case of bronchitis and one of fever ; a patient with phthisis and another with gangrene of the lung.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Headmaster of the Technical School, Oldbury—The Director of Education, County Education Office, County Buildings, Worcester (February 21).

Borough Engineer and Surveyor, Buildings Surveyor and Surveyor to the Local Education Authority—The Town Clerk, Town Hall, Eastbourne (February 29).

Headmaster at the Queen Mary's (Boys) School, Basingstoke—The County Education Officer, The Castle, Winchester (March 1).

Professor of Chemistry—The Registrar, University of Allahabad, Allahabad, India (March 31).

Professor of Physics—The Registrar, University of Allahabad, Allahabad, India (March 31).

Entomologist to the South African Sugar Association—The Director, Sugar Experiment Station, Mount Edgecombe, Natal, South Africa.

Temporary Meteorological Assistants (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

Engineer for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9113).

Assistant Engineer for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

Superintendent Engineer to the South Wellan Internal Drainage Board—Calthrop and Leopold Harvey, Clerks to the Board, Solicitors, Spalding.

Mineralogist or Geo-chemist—The Director of Research, British Pottery Research Association, Queen's Road, Penkhull, Stoke-on-Trent.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1938. Pp. v+277. (London : H.M. Stationery Office.) *4s. 6d.* net. [291

Ministry of Health. Memorandum on Scabies. (Memo. 229 Med.) Pp. 8. *2d.* net. Memorandum on the Louse and how to deal with it. (Memo. 230 Med.) Pp. 12. *2d.* net. (London : H.M. Stationery Office.) [22

Other Countries

Journal of the Indian Institute of Science. Vol. 22A, Part 21 : Investigations on the Nature of Additions of Aliphatic Diazo-Compounds to Conjugated Double Bonded Systems ; Action of Diazomethane and Ethyl Diazo Acetate upon Cyclopenta- and Cyclohexa-Dienes and their Derivatives. By P. C. Guha and G. D. Hazra. Pp. 263–274. 1 rupee. Vol. 22A, Part 22 : Synthetical Investigations in the Thujane Series, Part 9 : A New Method of Synthesis of Umbellulonic Acid, by P. C. Guha and M. S. Muthanna ; Part 10 : Experiments on a Total Synthesis of Thujone ; Synthesis of an Isomer of α-Thujadicarboxylic Acid (1-*iso*propyl-1-carboxy-*cyclo*propane-3-acetic acid), by P. C. Guha and M. S. Muthanna ; Part 11 : Synthesis of an Isomer of α-Thujadicarboxylic Acid (1-*iso*butyl-*cyclo*propane-1 : 2-dicarboxylic acid), by P. C. Guha and M. S. Nande. Pp. 275–286. 1 rupee. Vol. 22A, Part 23 : Reactions of Chromates at High Temperatures, Part 11 : Structures of Chromium Chromates. By D. S. Datar and S. K. K. Jatkar. Pp. 287–308. 1.8 rupees. Vol. 22A, Part 24 : Reactions of Chromates at High Temperatures, Part 12 : Magnetic Properties of Chromium Chromates. By D. S. Datar and S. K. K. Jatkar. Pp. 309–316. 12 annas. Vol. 22A, Part 25 : Synthetical Experiments in the Pinane Group, Part 6 : Further Attempts to Synthesise Pinonic Acid, Nopinone and Verbenone, by P. C. Guha and P. I. Narasimha Rao ; Part 7 : Total Synthesis of Verbenone ; a New Total Synthesis of α and β-Pinenes, by P. C. Guha and P. I. Narasimha Rao. Pp. 317–330. 1.2 rupees. Vol. 22A, Part 26 : Activation and Clarifying Properties of Fuller's Earth, Part 6 : Adsorption of Colouring Matter by Fuller's Earth in Decolorisation of Oils. By B. S. Kulkarni and S. K. K. Jatkar. Pp. 331–340. 14 annas. (Bangalore : Indian Institute of Science.) [301

Ministry of Public Health, Egypt : The Research Institute and the Endemic Diseases Hospital. Fifth Annual Report, 1935. Pp. x+68. (Cairo : Government Press.) [12

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1939. (Publication 3552.) Pp. ix+139. (Washington, D.C. : Government Printing Office.) 20 cents. [12

Catalogues

Catalogue of Optical Projection Apparatus. Part 3 : The 'Newton' and 'Wigmore' British Epidiascopes. Pp. 28. (London : Newton and Co.)

Epidemic Influenza Virus Suspension I.V.S. (B.D.H.). Pp. 8. (London : The British Drug Houses, Ltd.)

Natural History : Insecta Varia. (List No. 4.) Pp. 40. (Den Haag : Antiquariaat Junk.)

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SCIENTIFIC MANAGEMENT IN ADMINISTRATION

IN the reviews of the progress of the War which have been given from time to time by the Prime Minister in the House of Commons, the preliminary testing of many of the plans drawn up for the organization of the nation in time of war has been revealed. In these reviews, however, the actions of the armed forces or diplomatic matters have figured largely, and the home front as a whole has scarcely received the attention it merits. Particular aspects have been noticed, but the balanced and critical view of the whole economic effort of the nation, which is one of the main points in the argument for a Ministry of Economic Affairs, has been lacking.

Accordingly a broadsheet on the home front issued by Political and Economic Planning (P E P) a few weeks ago is the more welcome for the careful survey of the position and its constructive criticism of matters on which Government spokesmen have said little or nothing. The first of the subjects reviewed in this broadsheet, that of the higher machinery of Government—the functions of the Supreme War Council and the War Cabinet—has also been touched upon in two admirable articles by Mr. Hugh Quigley and Mr. L. Urwick in successive numbers of *Industry Illustrated*.

The P E P broadsheet, reviewing the establishment of five new ministries for war purposes and the vast new functions of three other departments, points out that the Cabinet secretariat remains the only body concerned with co-ordination over the whole field. While the appointment of Lord Stamp as adviser to a Cabinet Committee on Economic Co-ordination shows a recognition of the importance of planning an economic policy on a much wider basis, the new office in its present form does not constitute an Economic General Staff. Moreover, the development of regionalism in civil defence holds immense implications for a possible peace-time reorganization of our administrative system.

Mr. Quigley's and Mr. Urwick's articles make interesting comment on the question put by P E P, whether the Civil Service can meet the greatest demands made on it since it assumed its present form, and adapt itself to the new conditions with their primary call for decisions and planning. Mr. Quigley, emphasizing the importance of the efficient conduct of industry and of fitting the needs of war to an industrial machine which is allowed to develop normally and with the minimum interruption, makes the point that regulations tend to conceal the need for initiative and bold planning, when in truth more efficient management is needed.

No country appears to have made any serious effort to determine what are good and valuable industrial products in a period of war and what are bad and non-essential. Such knowledge, however, is basic for the efficient use of a country's industrial resources, and this kind of assessment requires the experience and knowledge of those in control of industry. Accordingly, Mr. Quigley urges the importance of bringing management into consultation to ensure the maintenance of the important volume of normal production, and to determine the limits beyond which any strain on industry or any further loss of its man-power would be a source of dangerous weakness.

Mr. Urwick, while endorsing Mr. Quigley's argument as to the support which industry and management could render in maintaining the economic life of Great Britain in a planned and ordered relation to the whole national effort, lays his main stress on the value of the principles and practice of scientific management in solving a whole series of difficulties now facing civil, military or naval authorities. Little progress has yet been made in the application of such principles and practices to the task of government, and Mr. Urwick indicates two directions in which scientific management could give important assistance. The first of these concerns ministerial co-ordination. At the very top, the British Government affords an example of infringement of the vital principle of span of control, according to which no man can co-ordinate effectively the work of more than five subordinates whose work interlocks. He urges that a true War Cabinet of half a dozen senior ministers without departmental responsibilities, giving continuous attention to policy and each responsible for co-ordinating a group of departments dealing with some special aspect of the national effort, is a necessity for the effective conduct of the War. Existing arrangements are technically faulty and therefore fundamentally unworkable.

Mr. Urwick's second suggestion, concerning the assistance which scientific management could give in the training and control of clerical staff in the Army, is illustrative of a number of directions in which the application of modern management principles could be of service in fields where administration generally is probably as efficient or more efficient than in industry. The importance of utilizing such services grows as the field over which control becomes essential is extended, and as the checks on autocracy are weakened through the suspension of municipal or parliamentary elections, or the disappearance of local initiative and radical modification of the whole basis of local government.

To neglect such matters is to court disaster, or at least to imperil the very work upon which we depend for the sustained effort and sacrifices demanded in a protracted struggle. Mistakes have already been made, as in the indefensible commandeering of schools and hotels, which have more seriously damaged the credit of the Government than its spokesmen care to admit. The absence of reform or evidence of contrition in such matters as these has consequences which are not the less serious because they are not immediate, and they may easily sap confidence at the very moment it is most essential.

Criticism in Great Britain of the control already exercised is indeed directed, not against the principle of control, but against the way in which some controls have been effected. The authors of imperfect plans—and the bunglers of good plans—cannot claim immunity from constructive criticism merely because we are at war. On the contrary, the onus lies on those who designed or are administering the controls to say where criticism is not justified. That such criticism has frequently been justified by its results and led to the withdrawal or modification of such schemes as those for the control of fish marketing, war risks insurance, or the Ministry of Information, is one of the most hopeful signs that the Government is not unresponsive to public opinion or unmindful of the necessity of safeguarding the liberty of the subject and inviting the co-operation of the public.

The most serious effect of such errors of judgment as the commandeering of hotels and schools is not the individual hardships involved, or the general irritation at stupid blundering, but the lack of confidence engendered in the smooth working of the vast national plans as a whole. The P E P broadsheet does not, with all its constructive criticism, suggest that there is anything essentially wrong with the principles of our war-time planning, though it indicates details in which criticism and public co-operation might improve matters. It does indicate, however, the existence of conflicting orders and a lack of co-ordinating authority, and the necessity of facing a drastic revision of traditional policies.

These points are specially stressed in relation to finance, to the planning of priorities, of man-power, agricultural policy and food control. All these, moreover, are clearly interlocked. In regard to finance, the war budget relies almost completely on the old system of taxation. The vital issue is to decide how much of the national income can be taken for war purposes, or what combination of price control, inflation, taxation and borrowing should be used for diverting enough of the national income from civil to military needs. One of the most difficult problems of war finance is how to control the dislocating effect of a vast increase in Government expenditure and the consequent widespread distribution of purchasing power at a time when a large proportion of the country's resources—labour, capital equipment and raw materials—is diverted from the provision of goods for current consumption to war purposes. The suggestion recently put forward by Mr. J. M. Keynes for dealing with this question of control of consumption by compulsory saving is a departure from the traditional policy which deserves careful examination, although good results are already being obtained by voluntary effort.

Such questions of finance are linked inextricably with the maintenance of export trade, and the question of exports and the distribution of export effort between the old heavy industries already fully engaged with war work and the newer light industries. It affects questions of prices, wages and profiteering and the planning of priorities. Clearly the Central Priorities Department should be used to plan the whole economic output of Great Britain and not just the supplies of the defence services. The needs of the civil population and of the export trades must also be considered and balanced against each other, if the most efficient use of available resources is to be secured.

Planning the utilization of Great Britain's resources of man-power to the best advantage is the function of the Ministry of Labour in consultation with the Labour Sub-committee of the Ministerial Priorities Committee. There is already evidence that lessons have been learned from the blunders of twenty-five years ago, and the compilation of the National Register should provide information for planning man-power much more comprehensively than before. It is doubtful, however, whether the true value of the Register in the scientific organization of a civilized community is yet realized. The Central Register has already proved its usefulness in placing certain classes of scientific workers where their services are most urgently needed; but it should be remembered that the whole register is experimental, and that experience is likely to suggest many improvements and extensions.

Complex problems of labour are bound to arise not merely in the munitions industry but also in agriculture and through the relations between rail and road transport, where fundamental reconsideration of the positions of both industries is urgently required. In agriculture, itself so closely linked with the question of food supply and rationing, a general clarification of aims is urgently required. Modern industrial, economic and scientific technique finds little reflection in much of the farming still practised; the pooling of all available knowledge in the service of war-time efficiency on the farm is as important as pooling labour, machinery, horses or even the land where the units are now too small to operate economically.

If, however, control and rationing are to be accepted with good grace, there must be confidence that adequate co-ordination of the national effort exists, and that steps have been taken to secure the scientific and impartial utilization of the full resources of the nation in the one purpose that counts. Rationing, whether of petrol or food or other commodities, will be accepted without demur so long as the private user does not feel that he is deprived of supplies for officials to waste. Scientific workers, who have their own contribution to make in so many widely different fields, should not therefore be unmindful of this supreme need for insisting that the fullest use is made of the methods and principles which scientific management puts into our hands, for securing the due co-ordination and efficient operation of any enterprise in the fulfilment of its purposes, whether they be those of a private business or of a nation at war.

THE ORIGIN OF LIFE

Life's Beginning on the Earth

By Prof. R. Beutner. Pp. x + 222. (London: Chapman and Hall, Ltd., 1939.) 12*s*. 6*d*. net.

THE "Manager of the Performance" as Prof. Beutner invites his readers to regard him, apparently supported by the Provost, Dean and staff of his Institute, stands on the stage before the curtains are drawn for the film. The technique is useful in that exact references to literature are unnecessary and concentration of eye and brain is secured. There is also no index and the mind is not usually disturbed by references to the sources from which the pictures are derived. These lapses make the film less useful to scientific men, while causing less strain on the commencing students of science and medicine for whom it is perhaps primarily intended. To these, all comparisons between the reactions of living and non-living matter cannot but present helpful analogies, which may well prove of great value to medicine, as suggested in the epilogue. The subject, however, has a wider appeal, for evidently certain of its sides have been the author's research life for many years. It deserves more than a passing reference.

As a practical presentation we suggest that the manager has reversed the order of the pictures of his film. We would feel greater happiness in leading off with the reactions of the oil drop to its environment in comparison with Amœba, because the layman learns the reactions called 'living' in connexion with tangible analogies that he can the better understand. Beutner, following on the pioneer work of Jennings, studied here, using Telkes drops made from fresh brain material which, of course, is rich in the lipoid lecithin. These are more complex than the drops of vegetable oils, but their method of preparation precludes the idea that they contain living matter. Experimentally they present many varieties of pseudopodia and of movement such as are found in the naked Protozoa[1], but there is never any increase of the mass. They exhibit respiration which in places lowers surface tension. The drops formed from the brain of an exhausted animal no longer show the mass of tiny fibres usual to those from the healthy animal. Poisons such as strychnine inhibit respiration and stop all movement, while, if free access of air is prevented, suffocation follows. No reactions can be recorded in pure water, for the drop is starved. The author next proceeds to a set of analogies in the phenomena of electrical actions in the nerve impulse, Lillie's researches freely quoted. He has studied the electric organs of fish and made artificial fat batteries which yield by analogy helpful results. His experiments suggest to him that poisons *may* kill by interference with the electrical mechanism rather than by their reactions on enzymes.

We pass by the numerous analogies between the actions of living cells compared with those of artificial gelatin cells, the formation of semi-permeable membranes and the magnitude of osmotic pressure. In this matter Traube's research (1860–70) can be read profitably by biologists even to-day, together with its subsequent development by Pfeffer. Leduc's imitations of many living forms are well illustrated, these artificial osmotic structures that counterfeit plant-growths amazingly well. "Salt and water are a part of life itself."

The consideration of the unique nature of carbon and its compounds leads the reader to basal considerations. The chemist, using elaborate technique, can make many carbon compounds that the organism produces with the greatest ease by means of enzymes or ferments. The most widely known is chlorophyll, the utility of which requires no comment. Usually any action necessitates the employment of several enzymes, so that the extraction of some in pure form has had no practical results. To this category perhaps belong the plant-formed vitamins, which in animals must be re-fed to the body continually to avoid disease. Then there are the hormones made inside the body and carried to where they have the highest activating influence, the best known being insulin. To-day, it is within our imagination to transform one of these bodies into a living body as, by radioactivity, elements can be transmuted. Naturally the search is for the smallest living matter and so we are led to the filtrable viruses[2], the disease-producing effects of which are well known. Their actions so closely simulate those of bacteria that life must be allowed to them. From these, crystalline substances were obtained by Stanley in 1935 using tobacco-mosaic leaves, afterwards those of phlox and spinach. These were repeatedly crystallized and found to produce the diseases at will, all facts being reasonably "explained on the assumption that the different virus proteins are in fact the different viruses". The problem for the chemist is to synthesize the enzyme and, this accomplished, to endow it with the property of self-regeneration. On this basis an idea of the development of cells is possible, with all that this entails.

We have omitted reference to the chapter devoted to "vital growth and crystallization" in which, as living matter is made up of diminutive crystals, the building forces are deemed to be similar in the living and non-living world. This leads to Beutner's review of Oparin's work "The Origin of Life", 1938. Condensations of nebular matter from the sun are assumed to produce planets[3], first carbon, then a series of metals, finally water, leaving the atmosphere as we know it; this is in contrast to the planet Jupiter with its methane-ammonia surround. Oparin suggests that organic substances were present in the early ocean as colloidal solutions. The interaction of various colloids caused segregation resembling crystallization, these "coazervates" gradually developing into living organisms. In this process enzymes must have formed in them so that they were able to assimilate substances from their environment. In contrast, Beutner maintains that self-regenerating enzymes formed by electric discharges were the earliest appearance of life—and it necessarily follows that such enzymes may have been formed at all ages in the world's history.

To summarize: research has shown developments of non-living matter strikingly resembling certain features of life, and the further development of such researches may at any moment illuminate the cosmic miracle by which life can only be supposed to have been produced either on this or any other world. J. STANLEY GARDINER.

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[1] This is perhaps due to liquid crystallization, a process seen in the central filaments of the Heliozoa. The surface covering of Amœba consists of protein and lipoid molecules so that the pseudopodia must be quite different.

[2] Their size is that of the molecule of hæmocyanin.

[3] This view is ascribed to "J. Jeans", who will scarcely desire to be termed "a Russian astronomer". Oparin apparently was not acquainted with Stanley's researches, for they are not included in his bibliography.

SALT DEPOSITS

Steinsalz und Kalisalze: Geologie

Von Prof. Franz Lotz. (Die Wichtigsten Lagerstätten der "Nicht-Erze", Band 3, Teil 1.) Pp. xxvii+936. (Berlin: Gebrüder Borntraeger, 1938.) 84 gold marks.

SALT deposits are of surpassing interest from many and varied aspects. The details of their depositional succession, their complexity and association, and the post-depositional changes which they have undergone provide a vast series of physico-chemical problems which have furnished material for the classic researches of van 't Hoff and a host of others. They are of no less interest to the geologist, who examines in them the record of those rarer episodes in the earth's history when the customary sequence solid-to-solution was reversed. Besides, salt, because of its great chemical and physical reactivity, is the most temperamental of rocks. So soon as it is laid down it is liable to be dissolved, transported, modified by solutions from above or below, and this any number of times. If it is involved in folding of the crust or tectonic events of any kind it reacts like no other rock; instead of folding as other rocks do, it flows, and under continued pressure it may become unstuck from its associates, penetrate higher levels of the crust in intrusive fashion as diapirs and salt plugs and may even flow out on the surface as salt glaciers. Countless surprises are possible if salt deposits are members of a rock series the geological history of which is at all lively.

Lastly, natural salts form one of the most important raw materials of industry. Like other mineral deposits, they are not uniformly distributed among the nations of the earth. In time of war, therefore, certain minerals become "strategic"—as the Americans put it—and of major importance among the strategic minerals are the potash salts. Germany, by virtue of her geographical position in the centre of the dried-up shallow sea of the great salt-building period of the Permo-Trias, has almost a monopoly of potash salts; it should be added that with regard to practically all other strategic minerals her native resources are inconsiderable. It is fitting from the academic point of view that Prof. Franz Lotze, of the University of Berlin, *ein guter Kenner der Salzlagerstätten*, should provide a monograph on the rock-salt and potash salt deposits of the world. It is fitting, too, from many other aspects, that this monograph should now be available at this present time to certain interested, but non-German, parties.

The *Salzband* of this well-known series dealing with the non-metallic mineral deposits is to consist of two parts. The first is the bulky volume under notice here and is concerned entirely with the geological relations of salt deposits. The second part, by Prof. Leonhardt, will provide an account of the mineralogy and petrography of natural salts; the physical chemistry of salt deposition is mentioned only incidentally in the geological part.

Every aspect of the geology of the deposits of sodium and potassium salts of the world is examined in complete detail. The book is divided into two sections. In the first a general geological account is given; in the second special descriptions of the world's salt occurrences are provided. As a start, salt formation at the present day is dealt with, and here is included a good discussion of the origin of the salt in the sea. Halley, as early as 1715, suggested that this was derived from the weathering of the rocks of the continents and thus started a notion which is still current and which, indeed, has formed the basis of one method, now discredited, of estimating the age of the oceans. But the oceanic waters have a content of chlorine far greater than could have been provided by the weathering of primary rocks. It is suggested that whilst the salt of the sea is all derived from primary sources, it has nevertheless arrived in the sea by two routes, the metals from primary igneous rocks, the non-metals from volcanic emanations—the two groups of components are separated by igneous processes but are reunited in sea-salts.

After describing the many types of salt deposits being formed at the present day, Lotze deals with the general geological principles of salt deposition in the past. The relation of salt formation to the great mountain-building periods, the southward migration of the salt-belts during the course of geological time and the origin of *thick* salt deposits are among the topics of interest discussed.

After an account of the secondary changes that salt deposits are liable to undergo so soon as they are laid down—a matter that will presumably be discussed in greater detail in Leonhardt's mineralogical part of the *Salzband*—there follows a full description of the almost fantastic tectonics of salt deposits. The various intrusive, unglued and rootless forms of salt bodies are related to the tectonic styles of the portions of the crust in which they occur. Structural geologists will find here matter of absorbing interest. The first section of this book, that dealing with the general geology of salt deposits, closes with some twenty-one pages of references.

In the second or 'special part' of the volume, detailed descriptions of the salt occurrences of the world are given, the general arrangement being based upon a regional geological foundation. Special attention is directed to the salt deposits of Europe and North America in relation to the large-scale tectonics of these continents. During the War of 1914–18 the virtual monopoly in potash salts possessed by Germany had become forcibly realized by other nations, and consequently there has been, in the post-War period, a strenuous search for new supplies, especially in the United States and the U.S.S.R. Most of the results of these campaigns, especially the Russian, are not readily available, but still Lotze provides a considerable amount of information on non-German occurrences of potash salts. He devotes most space—more than two hundred pages—to the consideration of the immensely important rock-salt and potash salt deposits of the Permo-Triassic basin of Middle Europe, which include the magnificent German potash salt fields and the not inconsiderable rock-salt deposits of the Trias in Great Britain. The elucidation of the various depositional cycles of the German fields, of the facies changes in them and of the palæogeographical conclusions to be drawn therefrom is made particularly clear. Details of national production are not given; these may be found in the current statistical summaries, such as Roush's "Mineral Industry". This 'special part' of Lotze's volume concludes with nearly fifty pages of references.

Fortified with its bibliographical detail, an index of more than a hundred pages, 353 text-figures and numerous tables, this work provides a summary of all that is known about the geology of a group of rocks of outstanding scientific, economic and international importance.

H. H. READ.

THE AMERICAN OUTLOOK ON COTTON

Cotton

History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing and Uses. By Dr. Harry Bates Brown. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xiii + 592. (New York and London: McGraw-Hill Book Co. Inc., 1938.) 30*s*.

IN the enlarged second edition, as in the first, the merits and weaknesses of this book are equally evident. It is a remarkable single-handed production giving the reader a wide view of every part of the cotton field, from the germ cell to the world crop of three million tons. Taxonomy, physiology, agriculture, merchanting, spinning, weaving and statistics are all included. We know of no better comprehensive presentation, and the quality of the citations is such that it can be used as a book of reference.

Its weakness results from the fact that extreme specialization on such a versatile crop as cotton involves the specialist in contacts with every subject under the sun, and in many of these he must be, however unwillingly, a dilettante. Also, he must reside somewhere, and when that residence is in the country which produces half the world-crop of his subject, his presentation must be biased by a tendency to overlook the smaller contributors.

Now, from a cotton-grower's point of view, the United States is mainly a mass-producer of unspecialized raw material, under conditions which as expressed in terms of yield per acre, are also unspecialized. Thus, while America must form the background to any book on cotton, the most advanced and informative work on cotton is nowadays to be found outside it, from countries where small crops present local difficulties, where specialized crops demand special care, or where, as in Lancashire, economic difficulties demand intensive study and research on the industrial end. This widespread area of information outside the United States of America has not been entirely neglected by the author, but it has not been adequately examined. We doubt whether it could be searched and critically sifted single-handed, but the transactions provided by the Shirley Institute in the *Textile Institute Journal* would be expected to provide some of the references in the chapter on cotton-spinning. Similarly, while Egypt is growing her whole crop from pure-line seed under a system of routine seed-renewal, with a yield per acre which is three times that of the United States and a price per pound which is half as big again, some references to Egyptian publications of later date than contributions by the present reviewer published more than twenty-five years ago should surely be of interest.

Substantially our criticism condenses to the title. If this were "Cotton from the American Point of View", we could praise without reserve.

W. L. B.

SOCIAL STUDIES IN ENGINEERING

(1) Spanning-Space
By Claude A. Claremont. ("Science in Action" Series.) Pp. 125. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 3*s*.

(2) The Development of Power
By Eugene C. Wittick. Pp. xiv+164. (London: Cambridge University Press; Chicago: University of Chicago Press, 1939.) 5*s*. net.

THESE two small books deal with engineering subjects in a popular way, and though their methods of treatment differ, there is a considerable measure of unity of plan to be observed in them.

(1) The first volume is an English publication, one of the "Science in Action" series the purpose of which is to describe, in a readable way, interesting and important activities and the scientific principles underlying them. Here the object is to explain to the general reader the several types of bridges in use and the ideas and principles on which their designs were based. The author, besides being an engineer, is co-principal of the Montessori Training College, London, and has dedicated his book to two small boys. He reasons out, in simple yet graphic language, the fundamental concepts in the design and construction of twelve different kinds of bridge. One could wish that such a book were largely adopted by teachers. The main subject is so familiar both to teacher and child. The historical notes and development, the properties of the materials suitable for each type, and the constructional details make up an impressive picture of purposeful adaptation which must convey a valuable lesson to a child's mind.

(2) In the second volume, the range of the subject is wider. It treats of the several sources of power and describes the machinery used to develop or transmit power in its different forms. The historical notes provide a background which explains and adds interest to later developments. This American publication is intended as a college text-book to stimulate the minds of students and to provide a source of information regarding the influence of this branch of engineering on social life. It may well be imagined that the Egyptian who had roughly devised a wheel which he could turn to raise water more easily than by buckets must have noticed that the flow of the river caused the wheel to turn. By combining the two functions he got a self-operating means of irrigation which left him free for other pressing work. The same simple impulses are at work to-day, though not so obviously, and if such books as these two were generally read and understood, the basic laws operating in our social life would be better appreciated.

A COURSE OF PHYSICAL CHEMISTRY

Kurzes Lehrbuch der physikalischen Chemie
Von Prof. Dr. Karl Jellinek. Heft 1: Grundprinzipien der physikalischen Chemie, Lehre von den reinen Stoffen und Mischungen von Nichtelektrolyten (Physikalisch-chemische Thermodynamik). Pp. xiv+314. 8.50 fl. Heft 2: Elektrochemie Phasenlehre, Lehre von den Phasengrenzflaechen (Kolloidchemie), chemische Kinetik. Pp. xii+292. 7.50 fl. (Deventer: N. V. Uitgevers-Maatschappij Æ. E. Kluwer, 1938, 1939.)

THESE are the first two of four parts of Prof. Jellinek's book, each part being independent. The first part deals with fundamental principles and their application to pure substances and mixtures of non-electrolytes.

The subjects fall under the two main headings of thermodynamics and kinetic theory, and in both cases the subject is fully and clearly treated, all mathematical requirements except the elements of the calculus being explained. There are many worked examples, and this is a very good feature of the book. The diagrams are neat and instructive, although the lettering is sometimes rather small, and there are some useful tables of numerical data. The symbols are well chosen, but a list of them would have been useful. The subjects include Nernst's theorem, which is dealt with from the modern point of view of entropies, and activity as far as it concerns non-electrolytes.

In most cases, alternative proofs of thermodynamic formulæ are given, one based on a cyclic process and the other on the thermodynamic functions, so that the reasoning is always made perfectly clear.

The second part of the book treats of electrochemistry, phase rule, surface and colloid chemistry, and chemical kinetics. The section on electrochemistry deals with electrolytes (including the modern theory of strong electrolytes), electrode potential and galvanic cells, and chemical equilibria with electrolytes (including indicators, heterogeneous equilibria, and fused salts). Although the Debye-Hückel equation is not actually deduced, it is very fully explained and illustrated by examples, and the idea of activity is introduced and used in a very complete and practical manner. The numerical examples frequently interpolated in the text make everything clear and intelligible, and there are many good figures.

The section on the phase rule deals only with one- and two-component systems but comprises well-chosen examples. The treatment of reaction kinetics includes the recent theories of active molecules as well as the classical examples, and the treatment of heterogeneous kinetics is very full, including a discussion of overvoltage and passivity, also comprising modern work.

There is no doubt that this book is likely to prove extremely helpful to both students and teachers, since the author has spared no pains to make the subject clear, understandable, and modern. A good feature is the close relation which is always preserved between theory and practical methods, the latter being explained briefly but adequately. If the remaining volumes of Prof. Jellinek's treatise are as good as these, the complete work will be an excellent survey of modern physical chemistry which will be certain of a warm welcome. The paper and printing are very good, but the number of small misprints is much larger than that included in the short list of errata.

OXFORD MEN OF SCIENCE

Early Science in Oxford
By R. T. Gunther. Vol. 11 : Oxford Colleges and their Men of Science. Pp. xvi+430+50 plates. (Oxford : The Author, The Old Ashmolean, 1937.) 30*s*.

DR. GUNTHER must be praised for the enthusiasm and hard work which have led him in the period between the Wars to found a museum for the history of science in Oxford and to give to science eleven volumes of part of its history. Some of this work has not escaped criticism, but the reception of most of it has been good. The present work is one that deserves a friendly welcome and an accessible place in the libraries of men of science and especially of Oxford men. Dr. Gunther has worked at his task with great energy and purpose, amassing from many sources, many of them little known (unfortunately not listed here), a large amount of interesting information on the personalities, aims and achievements of Oxford men of the past. Dr. Gunther happens to be more attracted to the antiquarian than to any other aspect of the past, to the biological sciences than to the physical, to instruments than to scientific ideas, to museums, perhaps, than to laboratories, and all he writes reflects the man. If we agree to accept Dr. Gunther as he is, and not to expect a cold, impartial historian, we shall have little to criticize and much to praise in this, his eleventh, volume.

The book begins with a survey of the whole subject in lecture form : the inaugural lecture given by the author in 1934 as first reader at Oxford in the history of science. Separate chapters, twenty-one in number, are then devoted to the colleges whose alumni in both the distant and recent pasts have made contributions to science. There is a final chapter on men like Robert Boyle who did scientific work in Oxford independent of the colleges, and there is a gather-up of material, not all of it relevant, in the form of seven appendixes.

In the chapters on the colleges, the worthies of each are presented in turn, their scientific achievements briefly described, and often some odd or out-of-the-way piece of information added ; sometimes a portrait is reproduced. 'Oxford man' is rightly interpreted widely, as anyone of scientific attainments who has been connected with a college, and not necessarily one who had been an undergraduate there. Thus, in the chapter on Merton College we are told of William Harvey, who was not originally an Oxford man, as well as of men like Sir Henry Savile and Grant Allen who were ; Robert Hooke properly comes under Christ Church, although much of his best work was done at the Royal Society in London. If the embrace had been less catholic, Dr. Gunther would have had little to do, for in the far past the number of Oxford men, in the narrow sense of having been undergraduates there, who stayed on after taking their degrees to do great scientific work, could be counted on the fingers of one's hands.

In the descriptions, a little expansiveness on the author's part would occasionally not have been amiss. In the chapter on Oriel College, we are told of the mathematical work of Prof. Baden Powell. Dr. Gunther might have added that Powell, who was elected into the Royal Society so long ago as 1829 and was old enough to have fought at Waterloo, was the father of the present Chief Scout. In the chapter on Christ Church, 'Dr. Tupper' is described simply as an inventor, a D.C.L. and an F.R.S. But he had these six welcome letters after his name before he was thirty-seven years of age, and he was the versifier whose christian name was Martin. Again, V. H. Veley, of University College, is mentioned as having shown that pure nitric acid has no action on copper, but nothing is said of the far greater work of H. B. Dixon, of Balliol, and H. B. Baker, of Christ Church. There was, in fact, at one time in Oxford a school which appeared to set out to show that pure things do not do what it is commonly supposed they do do, one member showing that pure nitric acid does not etch copper, another that carbon will not burn in pure oxygen, a third that pure iron does not rust, and a fourth that pure ammonium chloride does not dissociate thermally. Possibly Dr. Gunther would not regard these investigators as coming into the field of "Early Science".

As was to be expected, this book is well illustrated. The choice has been carefully made and the reproductions are numerous and very good. They include many little-known portraits of Oxford's scientific sons. A. S. R.

AMERICAN VEGETABLES

Vegetable Crops

By Prof. Homer C. Thompson. (McGraw-Hill Publications in the Agricultural Sciences.) Third edition. Pp. xi + 578. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 33*s*.

THIS book is the third edition of a standard American text-book dealing with the production and marketing of vegetables. Particular attention is paid to vegetables cultivated in the eastern States, and all the subtropical products from limited areas of Florida and elsewhere are omitted.

Nine years have elapsed since the previous edition, and opportunity is well taken to bring the text up to date, and to include consideration of recent research, carried out for the greater part at the Cornell Agricultural Experiment Station.

As in previous editions the earlier chapters deal with the principles and methods of cultivation, with soils, manures and fertilizers, and irrigation. A brief consideration of marketing and storage problems is included, but the major portion of the text is devoted to a systematic study of the commoner vegetables.

Although the underlying principles of cultivation do not differ from those laid down in most other countries, the very real differences between local climates and soil conditions, together with differences experienced in transport and marketing, overshadow these similarities. Further complications arise for English readers due to differences in nomenclature, to synonymy, and to different methods of varietal classification. An example or two must suffice: there is no entry in the index of haricot beans, a term applicable to certain varieties of dwarf French beans of which the young pods, but more especially the dried seeds, are so valuable; although the reader will find an alternative classification of beans according to their use, he will yet have to decide whether to include his haricot under snap beans (with edible pods) or dry shell beans. Similarly the classification of cabbages, although based on sound morphological lines, would not be entirely suitable for all our English varieties.

In regard to pests and diseases there are some of major importance in the States which fortunately are not yet with us, but our crops suffer from other pests and diseases which are of such little importance in America that they naturally receive brief attention in these pages; the pests of the potato illustrate this point.

The author includes the deficiency troubles due to a lack of boron, shown in cauliflowers by hollow stems and brown curds, in beet by black spotting, and shown by the brown heart of rutabaga, better known in Britain as swedes.

Although there are brief descriptions of the somewhat uncommon chayote (*Sechium edule*), and okra (*Hibiscus esculentus*) and martynia (as *Proboscidea Jussieudi* Keller) the author omits the yams (*Dioscorea sps.*), the Chinese artichoke (*Stachys tuberifera*), and the Peruvian oca (*Oxalis, crenata*) and other rarer vegetables.

A valuable feature of the book is the literature cited, comprising some five hundred titles, mostly of recent American work. The book appears in the well-known format of the series by the McGraw-Hill Publishing Co., and it is somewhat expensive.

The success of American and British growers in breeding and selecting varieties suitable for their own conditions tends to make this book of somewhat limited use to growers in another country, although its value to students, for whom it is written, is not thereby seriously impaired.

LIVE STOCK POLICY DURING WAR-TIME

BY DR. CHARLES CROWTHER,
PRINCIPAL OF THE HARPER ADAMS AGRICULTURAL COLLEGE

SINCE the eighties of last century, the main effort of British agriculture has been steadily and increasingly diverted from crop growing to the production of live stock and live stock products. According to recent statistics these now account for about two thirds of the total value of the agricultural output of England and Wales, and an even higher fraction of the Scottish output. This expansion of live stock production with a dwindling arable acreage has only been made possible by the import of feeding-stuffs, which has shown a corresponding rise to a level in recent years of about 7¾ million tons per annum. This represents, according to Wright's estimates, in terms of 'starch equivalent' about 22 per cent of the total nutrients consumed by live stock in a normal year (1935), the balance of 78 per cent being obtained from home-produced fodders, roots and corn. In these terms of gross supply, the proportion of imports does not appear to be unreasonable ; but in terms of concentrated foods the balance assumes a very different aspect, since imports are entirely of this class and amount to more than twice the home-grown supply of concentrates. It is inevitable, therefore, that in times of crisis involving shipping difficulties the supply of imported feeding-stuffs, unless vast reserves have previously been accumulated, must rapidly become a serious problem for the live-stock industry, compelling some change of policy, more or less drastic, for the early stages, if not for the whole period, of the crisis.

The general lines along which such adaptation must take place were evolved by force of circumstances during the War of 1914-1918 : increase of home production of arable crops, utilization of household and other food waste, and rationing of available concentrated feeding-stuffs with priority to those classes of animals which either make more economical use of these concentrates or give a product that is of special importance in the national dietary. In the present emergency, therefore, it has been possible from the outset to formulate the war-time policy for the production of live stock and live stock products along these lines, and with varying degrees of grace the broad principle of the policy appears to have been accepted by the industry.

The necessity for the 'speed the plough' and 'dig for victory' campaigns in the interests of the human consumer are obvious ; but both may also be made to contribute substantially to the home supplies of food for live stock, the former through the farm, and the latter through allotments and gardens. A parallel increase must also be effected on our grasslands, where modern research has greatly extended the possibilities of improved management and utilization, and of conservation of surplus produce for winter use. No great expansion of the artificial drying of grass by private enterprise on farms is probable, but serious consideration should be given at once to the possibility of establishing a national grass-drying organization, for which a large nucleus of raw material would be available on aerodromes and other large areas from which the grass needs to be cut and removed periodically through the growing season.

On the majority of farms a corresponding increase in conserved grass supplies would be more readily effected by ensilage, using improved modern methods, and an intensive propaganda directed towards this end ought to be initiated without delay.

By these two methods of conserving young grass, a very substantial reduction in the requirements of ruminant live stock for concentrated foods could be effected, and substantial help thereby given to the solution of the difficult problem of maintaining an adequate head of our non-ruminant stock.

It is on the latter—the pig and the fowl—that the penalty of depleted supplies of concentrates must necessarily fall most heavily, since they can only utilize coarse fodders to a very limited extent, not even sufficient to cover their maintenance requirements, and consequently must depend for the most part upon supplies of grain and meals. According to Wright's estimates of the normal requirements of these classes of live stock under prevailing systems of management, poultry receive 94 per cent, and pigs no less than 97 per cent, of their nutrients (expressed as starch equivalent) in the form of cereals and other concentrates. When these proportions are compared with the corresponding 15–20 per cent for cattle and sheep, and account taken of the paramount importance of maintaining an adequate supply of milk, it is clear that even with drastic changes in systems of management and feeding it will be practically impossible to prevent a considerable fall in the numbers of pigs and poultry. A considerable reduction in the output of pig meat, poultry meat and eggs from the normal sources of home supply can thus scarcely be avoided, although since the best stocks will be retained the fall in output from these sources will not be proportional to the drop in numbers. Greater recourse will also be made by pig and poultry farmers to the feeding of food refuse from hotels and camps, and of grassland and surplus greenstuffs. So far as the use of grass and greenstuff is concerned, however, it is one of the ironies of the situation that the main responsibility for this task of replacing concentrates by greenstuffs should fall upon the two classes of live stock that are least fitted for dealing with large quantities of this bulky, fibrous type of food.

If home supplies of eggs, poultry meat, and pig meat are to be substantially maintained, a new body of producers must be brought into existence, and that is the task now allotted to the cottager, 'back-yarder', and allotment holder. Every household and every vegetable garden produces a certain amount of waste, useless in the house but serviceable as food for small live stock. Such material is generally more easily and completely disposed of through the pig than the fowl, but for most people, especially in suburban areas, pig-keeping will be impossible, and the effort must be concentrated on fowls and rabbits. War-time economy, moreover, will surely reduce the normal volume of household 'scraps' available, and the keeping of even a few fowls or rabbits will only be possible where an organized collection of the scraps from several households can be arranged. In a community properly organized for the purpose, the best plan of all would be for the edible refuse of all kinds to be collected and taken to a communal live stock feeding centre where expert management and proper facilities for the preparation of the food could be provided. Such a centre, with good management, might well be a substantial source of profit to the community.

Before taking up poultry keeping, the 'back-yarder' will be well advised to bear in mind that his household scraps and garden refuse alone will not suffice to maintain his birds in good health and production ; but that he will also need to obtain a quantity of suitable meal, probably at least $\frac{3}{4}$–1 lb. per head weekly. Furthermore he must be prepared to go to a little trouble in boiling or cooking the scraps, as they may be unsuitable or even unsafe in the raw condition. Where garden waste is more abundant than house scraps he would probably be better advised to keep rabbits than poultry, since the rabbit can deal effectively with larger quantities of greenstuffs than the hen, and is generally less fastidious in its appetite for this class of food. Incidentally also, it is perhaps less liable to create a nuisance. German war-time policy for the 'back-yarder' definitely favours the rabbit before the hen, and its possibilities might well receive more attention and publicity in Great Britain than they have yet received.

Whatever class of live stock is favoured, however, it must not be assumed to be a simple matter on which no expert advice is required, and every community in which this class of activity develops should provide an organization through which such help can be readily obtained. There should be no difficulty in any town in forming an advisory panel of experienced men and women, with whom might be associated the adviser on small live stock from the agricultural educational staff of the adjoining county authority. Further assistance is also available in the special leaflets issued by the Ministry of Agriculture and Fisheries.

With all the assistance that may come from the cottager and 'back-yarder', however, the major part of the problem of conserving the greatest possible nucleus of our live stock must lie with the farmer, and must turn upon the efficiency with which our grassland and our reduced supplies of concentrated foods are utilized. There is general agreement that in the interests of children and others for whom milk is almost a vital necessity, and in view of our entire dependence upon home supplies of this commodity, priority in the allocation of feeding-stuffs must be given to milch cows. Beef cattle and sheep are regarded as having the next best claim to consideration, partly because of their relatively low requirement of concentrated feeding-stuffs in proportion to their total food consumption, and partly because of the slowness with which any reduction in our cattle and sheep stocks can be remedied after the War. Poultry and pigs follow without any special discrimination between them in the national policy, although the poultryman may justly claim precedence on grounds of the special nutritive virtues of the egg, through its combination of high nutritive energy with 'protective' factors. From this point of view, indeed, the hen may claim to rank next to the dairy cow in the basic importance of its contribution to the national dietary.

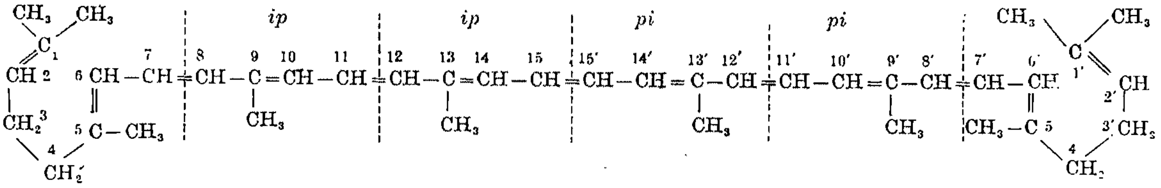
Placed at their present disadvantage in the order of priority, the pig farmer and poultry farmer have clearly the right to insist that every care shall be taken to ensure that the more favoured classes of live stock are efficiently managed, especially as regards their user of imported feeding-stuffs. This can only be effected satisfactorily through an organized scheme of rationing of supplies. Under such a scheme the dairyman, cattleman and sheepman should only receive priority supplies for their surplus production beyond the level that they may reasonably be expected to cover from home-grown supplies of fodder and grain. Furthermore, the total volume of milk and meat production in respect of which priority of foodstuff supply is given should be restricted to the *essential* needs of the public. A volume of milk, for example, that is ample for the needs of infants, adolescents, invalids, etc., must be assured at all costs ; but in view of the serious position in which pig and poultry producers are placed, it is difficult to see why any priority should be given for the production of unlimited supplies of milk for consumption by the adult population.

With the increased arable acreage and intensified utilization of grassland the requirements of the ruminant live stock for imported concentrates should be very substantially reduced, and the pig-man and poultry-man have every right to expect this measure of co-operation from their more favoured fellow farmers.

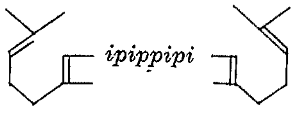
In the case of the poultry-man, and to a smaller degree the pig-man, there are also other weighty considerations that must be taken into account in the development of national policy. A very large section of the poultry industry is in the hands of 'small' people scattered throughout the countryside, whose living and life-savings are entirely bound up with the maintenance of their small enterprises. The welfare of this smallholder element of the agricultural community has always been regarded as being of great importance to the interests of the State, and any ill-considered reversal of this policy, even in war-time, may have grave sociological consequences. Their problem is for the time being extremely difficult, but must receive serious consideration before we can resign ourselves to the inevitability of human sacrifice on the home food production front.

CAROTENE AND ALLIED PIGMENTS*

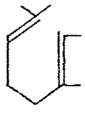
THE simplest carotenoid is lycopene, $C_{40}H_{56}$; on complete hydrogenation to perhydrolycopene, $C_{40}H_{82}$, thirteen bonds disappear. Quantitative degradation by means of ozone, permanganate and chromic acid as oxidizing agents leads to the formula:



The central polyene chain, C_8–$C_{8'}$ inclusive, is made up of four isoprene units arranged in pairs which are united in reverse order at C_{15} and $C_{15'}$, and may be abbreviated as *ipippipi* (*ip* denoting an isoprene unit). Lycopene may thus be written



The polyene chain is common to a large number of carotenoids, but the terminal groups may consist of substituted or unsubstituted rings of the α- or β-ionone type as below :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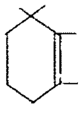
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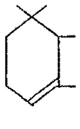
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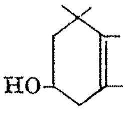

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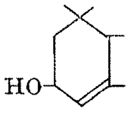

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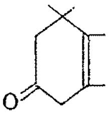

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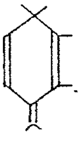
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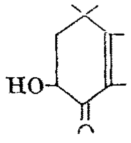

h

Green leaves and other vegetable products contain α- and β-carotene and 'xanthophyll', a mixture of hydroxylated carotenoids, zeaxanthin and lutein predominating. Their functions in plant physiology are not yet understood, but owing to the connexion between carotene and vitamin A, the position concerning the role of carotenoids in the nutrition of animals is much less obscure.

Vitamin A from fish liver oils ($C_{20}H_{29}OH$) possesses a constitution which differs from one half of the symmetrical β-carotene molecule only by the addition of the elements of water:

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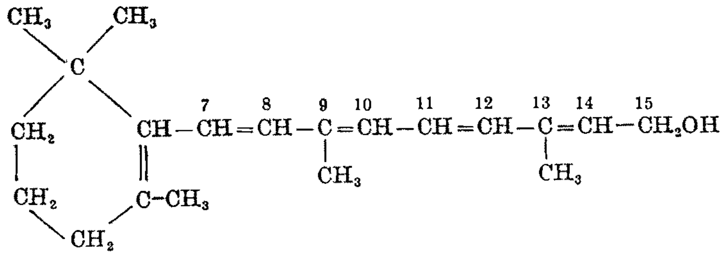
* Based on papers by Dr. R. A. Morton "On the Constitution and Physiological Significance of Carotene and Allied Pigments", and W. M. Seaber, "On the Commercial Determination of Carotene and Allied Pigments with Special Reference to Dried Grass and other Leafy Materials", read at a joint meeting of the Society of Public Analysts and Other Analytical Chemists and the Food Group of the Society of Chemical Industry on February 7.



The fact that green foodstuffs may cure avitaminosis A just as well as fish liver oils was explained when it was found that pure 'carotene' undergoes fission *in vivo* with formation of vitamin A.

The only carotenoids which act as precursors or provitamins A are those which possess intact one half of the β-carotene molecule. They include those shown in the accompanying table, echinonene and a few derivatives prepared *in vitro* from natural provitamins. There is no evidence that animals can synthesize either provitamins A or vitamin A *de novo*, or that the conversion of carotene to vitamin A is reversible.

Substance	Constitution	Occurrence
Lycopene	*a-ipippipi-a*	Ripe tomatoes
* α-Carotene	*b* ,, *c*	Red palm oil, mountain ash berries
* β-Carotene	*b* ,, *b*	Carrots, leaves, etc.
* γ-Carotene	*b* ,, *a*	Leaves of lily-of-the-valley
* Kryptoxanthin	*b* ,, *d*	Yellow maize
Zeaxanthin	*d* ,, *d*	Maize, egg yolk, leaves
Lutein	*d* ,, *e*	Grass, green leaves
* Myxoanthin	*b* ,, *g*	Algæ, especially blue-green algæ
* Aphanin	*b* ,, *f*	
Rubixanthin	*d* ,, *a*	
Astaxanthin	*h* ,, *h*	Crustacea

* Provitamins A.

The animal body contains only small quantities of carotenoids, and is not equipped to assimilate large doses. Carotene utilization is optimal when minimal doses are fed in oil solution, and the transport of carotene through the intestinal wall is conditional on normal fat absorption. The site of the conversion of carotene to vitamin A is generally held to be the liver; certainly the liver is the main storage depot for the vitamin. In most species there is a normal level of concentration of vitamin A—and of carotenoid—in the blood. Carotenoids are also found in the pigmented layer of the eye and in yellow bone marrow.

Milk contains both vitamin A and carotenoids (largely β-carotene) and for a given species the total vitamin A activity of normal milk tends to be fairly constant, but in domesticated animals there are interesting variations with breed. Thus Holstein and Ayrshire cows yield milk with little carotene but more vitamin A, whereas Guernseys give a cream more deeply coloured by carotene but less rich in vitamin A. The new-born possess very low liver reserves of vitamin A, and it is significant that colostrum may possess vitamin A activity one hundred times that of normal milk. Human colostrum is two or three times as potent as early milk, which in turn is five or ten times as rich as the later milk.

The earliest sign of shortage of vitamin A or provitamin A is defective low-intensity vision. Visual purple, the photosensitive substance of the rods, may be obtained from retinas; it is a conjugated protein from which vitamin A can be separated. Faulty dark adaptation is due to delayed regeneration of visual purple, and in the majority of subjects can be remedied by supplementing the diet with vitamin A or carotene. In order to prevent night blindness in cattle, sheep, pigs, rats and horses, Guilbert finds that either some 25–30 μgm./kgm. body weight (1 μgm. = 10^{-6} gm.) of β-carotene or 6–8 μgm./kgm. of vitamin A is needed daily.

Outspoken vitamin A deficiency is characterized by widespread atrophy of epithelial structures and often by xerophthalmia, but retardation of growth (weight) is the criterion most readily amenable to quantitative interpretation.

The diet of the majority of town dwellers shows inadequate vitamin A activity, especially during the winter months. It is also certain that most winter milk from stall-fed cattle is inferior to summer milk. Artificially dried grass is superior to hay both in respect of protein and provitamin A content, and its value as a feeding stuff has been established in many well-controlled experiments. The addition of vitamins A and D to margarine is a valuable way of alleviating vitamin deficiency, but the problem of utilizing the available resources to the best advantage and of increasing the supply to meet the known needs has not been solved. That it is necessary and possible to do so cannot be doubted, nor that the cost of effective action would be a small fraction of the cost of inaction.

This raises the point of the relative efficiency of carotene and vitamin A. The accepted unit of vitamin A activity is that exerted by 0·6 μgm. of pure β-carotene, so that the pure substance has a potency of $1{\cdot}66 \times 10^6$ I.U./gm. (by definition). Vitamin A, according to the best available data, has a potency near $3{\cdot}0$–$3{\cdot}3 \times 10^6$ I.U./gm., whereas all provitamins other than β-carotene have an activity near $0{\cdot}83 \times 10^6$ I.U./gm. These figures apply to rats receiving minimal doses.

There is urgent need for more research on the relative efficiencies of provitamins and vitamin A at the level needed to convert a marginal diet into an optimal diet.

The commonly accepted view that the equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \xrightarrow{2H_2O} 2C_{20}H_{29}OH$$

corresponds with a process occurring *in vivo* would lead to 1·56 × 10⁶ I.U./gm. for pure vitamin A. This is not in accord with experience; it rests upon the assumption that fission occurs exclusively at C15—15′ double bond, and its only advantage is that it agrees with the superiority of β-carotene over other provitamins. Unsymmetrical fission is more plausible and an equation

$$\underset{\beta\text{-carotene}}{C_{40}H_{56}} \rightarrow C_{20}H_{29}OH + \text{decomposition products}$$

is in closer harmony with the observed potency of vitamin A.

Vitamin A is estimated spectroscopically by utilizing the absorption maximum at 325 mμ. There is at present no reason to justify changing the accepted conversion factor, namely:

$$E^{1\%}_{1\text{cm.}}\ 325\ \text{m}\mu,\ 1 = 1{,}600\ \text{I.U./gm.}$$

The estimation of carotene in dried grass and similar materials involves extraction of the pigments, preparation of non-saponifiable extracts and a phase separation (that is, partition between petrol ether and 90 per cent methyl alcohol). The provitamins appear in the hydrocarbon solvent and the xanthophyllic compounds are eliminated in the aqueous methyl alcohol. Chromatographic adsorption permits a finer separation of individual carotenoids, specially prepared alumina, lime, calcium carbonate, magnesia and soda ash being good absorbents for particular purposes. The carotene, freed from 'xanthophylls', is evaluated spectroscopically or colorimetrically.

Dried grass and similar products are now important sources of provitamin A for animal feeding. The following method of analysis has been thoroughly tested and found to be satisfactory by the Grass Driers' Association:

> 0·25 gm. dried grass is ground thoroughly with sharp silver sand (5 gm.) and the mixture is treated with a mixture of acetone (15 ml.) and petrol ether (45 ml.) in a continuous drip extractor for at least 1 hour. The cooled extract is transferred to a separating funnel using a little petrol for washing in, and 30 per cent methyl alcoholic potash (5 ml.) is added. Vigorous shaking for two to five minutes is followed by addition of water (200 ml.). Carotene remains in the petrol, and after washing with water (200 ml.) the 'xanthophylls' are removed by shaking the petrol ether three times with 90 per cent methyl alcohol. The petrol layer is retained and made up to known volume. A solution of potassium dichromate (0·025 per cent) is colorimetrically equivalent to a solution of β-carotene containing 0·158 mgm. per 100 ml. petrol ether.

The estimation of carotene is complicated by the presence in the petrol ether fraction of a variable amount of an *X*-substance, which may be eliminated by filtering through a short column of alumina after adding 3 per cent of acetone. A yellow impurity is adsorbed but the carotene is carried through. Dr. Kon has confirmed the observation that the percentage of this contaminant increases in dried grass on storage.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COLUMBUS MEETING

BY DR. F. R. MOULTON, PERMANENT SECRETARY OF THE AMERICAN ASSOCIATION

IN many respects the American Association for the Advancement of Science is similar to the British Association, which served as a model for its organization and early development. It is the great democratic scientific organization of America (using the word in the geographical, not the national, sense), including in its interests all of science and its applications and relations to society. During a period of rapid increase in specialization and the organization of special scientific societies, it has served as an integrating agency. The breadth of its scope and the number of its members, now exceeding 20,000, make its voice more and more the voice of science in America.

In certain respects, however, the American Association differs from the British Association. Perhaps the least important is that it holds two meetings each year, the annual meeting during the Christmas holiday week (this year December 27—January 2, inclusive) and another meeting in the summer, usually the latter part of June. In addition, because of the large area of America, it has two geographical divisions, the Pacific Division and the Southwestern Division, each of which holds one meeting each year. A greater difference between the two associations is in the nature of their programmes. Before stating this difference, I wish to point out that many special scientific societies and organizations, at present 174 of them, are affiliated with the American Association, meet with it at their option, and have representation on its Council, its supreme governing body. As a consequence of this organization, the American Association programmes, instead of consisting of a rather small number of important addresses by distinguished men of science, include many sessions before which hundreds of papers are read. At the recent meeting in Columbus, Ohio, in about four days a total of 259 scientific sessions were held, before which 2,154 addresses and papers were presented. Naturally there was none of the delightful leisureliness of the meetings of the British Association.

Although many, probably most of the 2,154 papers presented at the Columbus meeting were of no considerable importance, yet a considerable number were distinguished. As an example, I may refer to the paper by I. I. Rabi on "Radio Frequency Spectra of Atoms and Molecules", for which the Thousand Dollar Prize of the Association was awarded. Dr. Rabi not only discovered radiations from atoms of much lower frequency than hitherto known, but also devised a method of determining their properties although they are far too feeble to be detected by any of the devices previously in use. It is not possible to pick out from the hundreds of other papers—75 in physics, 44 in chemistry, 56 in astronomy, more than 300 in the zoological sciences, more than 350 in the botanical sciences, an equal number in genetics and other general biological sciences, 67 in the medical sciences, 310 in agricultural science—a few for special comment without injustice to many others.

On the whole, the best part of the programme from the point of view of direct contributions to science was the symposia, often organized and presented by several sections and societies in co-operation. These symposia were on such subjects as "Applications of Mathematics to the Earth Sciences", "Photosynthesis", "Fifty Years of Entomological Progress", "Speciation", "Effects of Science upon Human Beings" and "Blood, Heart and Circulation". The Association has published in book form the most important of the symposia presented at its meetings during the past three years.

Perhaps the foregoing paragraphs might lead the reader to conclude that the programmes of the American Association do not include the general sessions which are so characteristic of meetings of the British Association. The American Association has such general sessions, often of distinction, but relatively to the remainder of its programme they are much less important than those of the British Association. In addition to the address of the retiring president of the Association, there are two regular evening general sessions, one under the auspices of the Society of the Sigma Xi, an honorary scientific society, and one under the auspices of the Phi Beta Kappa, an honorary scholarship society. The retiring president of the Association, Dr. Wesley C. Mitchell, chose for the subject of his address "The Public Relations of Science" [see NATURE, Feb. 10, p. 207]. The annual lecture under the auspices of the Society of the Sigma Xi was delivered by Dr. Kirtley F. Mather on "The Future of Man as an Inhabitant of the Earth". The Phi Beta Kappa address was by Dean Marjorie Hope Nicolson on "Science and Literature".

This year saw the initiation of two new general sessions, one under the auspices of the Honor Society of Phi Kappa Phi and the other under the arrangement between the British Association and the American Association for exchange lectures on alternate years. The former was delivered by Dr. Isaiah Bowman, president of the Johns Hopkins University, whose subject was "Who is Responsible for Peace ?" As British men of science will recall, Dr. Bowman was invited by the officers of the British Association to deliver at its meeting last September the first of the British and American Association Lectures.

Although the first lecture by a British man of science under the arrangement was not due until next June, the arrival of Dr. Julian S. Huxley in America just before the Columbus meeting presented an opportunity that could not be neglected. He was invited to deliver the first lecture by a British scientific worker and accepted the invitation. His subject was "Science, War and Reconstruction". In referring to this brilliant address in my report of the meeting, I wrote as follows :

"The address of Dr. Huxley illustrated the scientific ideals of impartiality, justice and altruism, not simply as ideals without immediate applications but as ideals that are urgently needed at this hour. Obviously there is now a tide in the affairs of scientists that taken at its flood may enable them to make the greatest contribution to the progress of mankind in the history of the world, but neglected may leave them in the position of having provided the bark on which civilization will drift back into the darkness from whence it came. It is gratifying that so many addresses and programs of the association and its affiliated societies gave concrete evidence of a deep feeling of responsibility of scientists to society. These responsibilities include also the more fundamental one of laying foundations for an organization of society based on the essential nature of man ; and they include the still deeper one of deriving from the laws of the inanimate and animate universes about us and within us a basis for ethics whose authority for acceptance shall be in our own hearts."

OBITUARIES

Prof. Alfred Wohl

PROF. ALFRED WOHL died in Stockholm on December 25, 1939, at the age of seventy-six years. He was born on October 3, 1863, at Graudenz and received his early training at the Universities of Heidelberg and Berlin. He obtained his doctorate in 1886 at the University of Berlin, working under the supervision of Prof. A. W. von Hoffman, and spent the next two years in the Laboratorium des Vereins für Rübenzuckerindustrie, Berlin. In 1891 he became *Privat-dozent* in Emil Fischer's laboratory in the University of Berlin, and in 1904 was appointed director of the Laboratory for Organic Chemistry and Technology at the Technische Hochschüle, Danzig, a post which he held until he retired on reaching his seventieth birthday in 1933.

During a period of almost fifty years uninterrupted research, Wohl made many important contributions to both organic and physical chemistry. His early connexion with the sugar industry probably laid the foundation for his deep interest in this branch of organic chemistry. We owe to him methods for the degradation of sugars, the preparation of the optically active glyceraldehyde and much of our early knowledge of fermentation enzymes. He also devised methods of making artificial honey which are still in use to-day, and during the War of 1914–18 produced an economical process for growing yeast.

In other branches of organic chemistry, Wohl carried out the synthesis and investigation of many important compounds such as phenylhydroxylamine, the semi-aldehyde of malonic acid, malic and tartaric dialdehydes, lactic acid aldehyde, the acetal of methyl glyoxal, and the preparation of glyoxal by the interesting method of the ozonization of acetylene. He also showed that nitrobenzene reacts with potash to give nitrophenol.

One of Wohl's outstanding achievements was the demonstration of the wide applicability of vanadium pentoxide as an oxidation catalyst; by its use he carried out the oxidation of naphthalene to phthalic anhydride and of anthracene to anthraquinone, and thus opened a new path to the cheap production of intermediates for the dyestuffs industry.

Wohl always showed a fervent interest in the theoretical aspects of organic chemistry, and developed a theory of chemical reactivity based on Michael's theory of primary association of reaction spots and on the polarity of linkages. Much of his work was devoted to the substantiation of these ideas and in this respect he made special studies of the reactivity of bromacetamide, hydrazonium compounds, and of the Friedel-Crafts synthesis. His interest in theory extended to physical chemistry and his most important contribution in this field was the formulation of an equation of state for gases, based upon a simple modification of van der Waals' equation. He also published a series of papers in the *Berichte* on methods of analysis of gases. In developing these methods, he devised a new type of glass tap and also a means of producing vacua suitable for low-pressure distillations by the use of charcoal cooled by liquid air and an ordinary filter-pump.

Wohl was a man of outstanding personality and an enthusiastic, ardent, and inspiring teacher. He spared no effort to help his students, and during term it was his daily practice to gather them together in small groups in the laboratory and discuss with them their research problems.

Many honours were conferred on Wohl. He held the office of president in the Deutsche Chemische Gesellschaft in 1933 and was given the honorary degree of Dr.Ing. of the Technische Hochschüle, Hanover, in 1928, and Dr.Agr. of the Landwirtschaftliche Hochschüle, Berlin, in 1931.

Although he retired in 1933, he carried on experimental work until 1938, and in his last years developed a process for the manufacture of pulp from fibrous vegetable materials.

Mr. R. A. Smith

WE regret to record the death, at the age of sixty-six years, of Mr. Reginald A. Smith, formerly keeper of the Department of British and Medieval Antiquities of the British Museum, which took place at Colchester on January 13.

Reginald Allender Smith was born in 1873 and educated at Christ's Hospital and University College, Oxford. In 1898 he was appointed to the staff of the British Museum in the Department of Ethnography and British and Medieval Antiquities, as it then was, of which Charles Hercules Read was at that time keeper. Smith was assigned to the archæological collections, of which he became keeper in 1927, after the ethnographical collections had become a distinct department. He retired in 1938.

Smith was fortunate both in his chief and in the nature of his duties—the care and arrangement of the prehistoric and early historic collections of antiquities of the Museum. By his association with Read he was trained in that appreciation of the significance of form and technique in which his chief was pre-eminent, while his care for, and arrangement of, the collections committed to his charge developed to the full his capabilities of scientific precision in observation and interpretation of detail which enabled him during a period of nearly forty years to make to the advancement of archæological studies a contribution which was no less valuable than it was individual, and, indeed, unique.

A variety of circumstances combined to afford Smith the opportunity to attain the position which he afterwards held in the archæological world. Of these, one of the most influential was the part assigned to him in carrying out the policy initiated early in his career at the Museum of issuing guides to the archæological collections, of which the first, on the Stone Age, appeared in 1902. Smith was mainly or solely responsible for the valuable guides, both in the original and in the revised editions, to the Stone, Bronze, and Iron Ages collections as well as to those of the Romano-British and Anglo-Saxon periods.

The preparation of these guides demanded an intimate and detailed knowledge and understanding of the characteristics of each individual specimen in the collections in relation to general typology as well as to the development of theoretical reconstruction in prehistoric and early historic studies. An even broader view was demanded in Smith's contribution of archæological chapters to early volumes of the "Victoria History of the Counties of England", which had commenced publication also early in Smith's career.

This thorough grounding in knowledge of the detailed evidence bearing upon British archæology proved of enormous service to scientific studies when Smith in 1908 joined the Council of the Society of Antiquaries of London, and afterwards became its honorary secretary and then its director, an office which he held for many years. Through the ramifications of the Society's many activities he was in close touch with archæological research in the field throughout Britain as well as on the Continent. Not only did he himself make many valuable contributions to archæological literature in its technical periodicals—his most considerable publication was an exhaustive illustrated catalogue of the Sturge collection of stone implements—but also he came to be widely recognized as, in a sense, a court of final appeal on the value and significance of any new discovery, or any fresh evidence bearing on previously ascertained facts in the prehistoric field of Britain. In the records of archæological discovery of the last twenty years, no name, with the possible exception of that of the Abbé Breuil, is more frequently quoted as responsible for an authoritative and final opinion than that of Reginald Smith.

Mr. G. L. Bates

Mr. G. L. Bates, who died on January 31, was born in the State of Illinois in 1863. He was the eldest son of a large family, and inherited his love of natural history from his mother. He was educated at Galesburg and Chicago, and it was his father's wish that he should enter the Church. However, he had a great desire to travel and study Nature, and he persuaded his father to send him to West Africa in 1895. His first years were spent in Gabon and the French Congo, and later he settled in the former German colony of Cameroon.

In 1896 Bates began to send collections to the British Museum, and up to 1928 there was a steady stream of specimens in all groups. Though primarily an ornithologist, Bates did not confine his collecting to birds, and he had the reputation as a very successful collector of reptiles, discovering some sixty-two new species, including *Rana goliath* and *Trichobatrachus robustus*, the curious hairy frog. In mammals, too, he made many discoveries, and his specimens of plants and fishes are models of careful collecting. From 1923 onwards he made many expeditions to different parts of West Africa, including a trip to the Southern Sahara, where he made some interesting observations on the affinities of the Saharan avifauna. Later he undertook the study of Arabian birds, and in 1934 paid a visit to Mr. H. St. J. Philby at Jedda.

Apart from his expeditions, Bates will always be remembered for his papers on the reversed under-wing coverts of birds, and his study of the genus Smithornis. In this last he proved by anatomical evidence that the genus had nothing to do with the normal Passeres. This was confirmed later by P. R. Lowe, who demonstrated that the true position was in the Asiatic Eurylæmidæ. Perhaps Bates's most important contribution to ornithology was on the "Geographical Variation within the Limits of West Africa", in which he showed that these variations, whether in colour or size, fall within certain rules. In 1930 he published a useful little "Handbook of the Birds of West Africa".

Bates's shy and retiring nature was increased by long residence alone, but nevertheless, no one was more ready to help others, and he will be missed by many. In the late autumn he underwent a serious operation from which he never fully recovered.

N. B. Kinnear.

Prof. Fritz de Quervain

Prof. Fritz de Quervain, an eminent Swiss surgeon, who died last month at the age of seventy-one years, was born at Sion, the capital of the Valais Canton, on May 4, 1868. He received his medical education in Bern, where he was assistant to Kronecker the physiologist from 1889 until 1891 and to Langhans the pathologist from 1891 until 1892, when he qualified. For the next two years he was assistant in Kocher's surgical clinic, and then entered on a surgical practice at Chaux-de-Fonds, where he became director of the surgical clinic in 1897. In 1902 he returned to Bern, where he remained until 1909, when he was appointed professor of surgery in the Basle faculty of medicine, and finally in 1918 occupied the corresponding chair at Bern.

We regret to announce the following deaths:

Lieut.-Colonel J. A. Amyot, C.M.G., lately Canadian deputy minister of pensions and national health, formerly professor of hygiene in the University of Toronto, aged seventy-two years.

Colonel R. E. B. Crompton, C.B., F.R.S., a pioneer in electrical engineering and mechanical road traction, on February 15, aged ninety-four years.

Mr. H. G. Newth, lecturer in zoology in the University of Birmingham, on February 17.

Prof. C. Tangl, director of the Institute of Experimental Physics, University of Budapest, on December 10, aged seventy-one years.

NEWS AND VIEWS

Waynflete Professor of Physiology, Oxford

ANNOUNCEMENT has been made of the appointment of Dr. E. G. T. Liddell, of Trinity College, Oxford, to the Waynflete chair of physiology in the University of Oxford, which has been vacant since last autumn owing to the death of Prof. J. Mellanby. Dr. Liddell graduated in medicine from Oxford and St. Thomas's Hospital, and returned to the University as assistant in physiology in 1921. He collaborated in much of the later work of Sir Charles Sherrington, including the studies on the stretch reflex, the publication of the "Reflex Activity of the Spinal Cord", and the revised second edition of "Practical Exercises in Mammalian Physiology". He was thus intimately associated with the Sherrington School. His particular interest has naturally been the physiology of the nervous system, and his more independent published papers have been concerned with studies on the knee-jerk, physiology of the cerebellum and spinal cord. He has also published work on the experimental production of high blood pressure in animals. Latterly he has elaborated a technique for study of the postural reactions in the limbs of the intact animal over a long period of time, thus exploring the effects of lesions of the spinal cord and corpus striatum by operative means. He has made himself an authority on this particular branch of the subject, hitherto neglected in Great Britain.

Prof. Liddell was elected fellow of the Royal Society last year. As fellow of Trinity College, Oxford, since 1921, he has gained a wide reputation as tutor and will be greatly missed in this sphere of university life. His long experience as examiner and tutor, his wide interests and thoughtful outlook, all combine to make him unusually well suited to the chair, and we wish him every success.

Guthrie Lecturer of the Physical Society

THE twenty-fourth Guthrie Lecture of the Physical Society will be delivered at 5.30 on February 26 at the Royal Institution by Prof. P. M. S. Blackett, professor of physics in the University of Manchester. The subject of the lecture is "Cosmic Rays: Recent Developments". Prof. Blackett served with the Royal Navy in 1914–19, having previously been at the Royal Naval Colleges at Osborne and Dartmouth. After the War he exchanged a naval for a scientific career and went up to Magdalene College, Cambridge. In the Cavendish Laboratory he began work with the Wilson cloud chamber, a technique of research to which he has remained faithful. His work during 1923–1933 was concerned with the alpha particle. He showed that alpha particles make nuclear collisions in which energy and momentum are very accurately conserved, but he also investigated collisions resulting in nuclear disintegration, and showed, for the first time, that in a Rutherford disintegration of the nitrogen nucleus the alpha particle is absorbed and a proton liberated.

In 1932 Blackett developed the counter-controlled cloud-chamber device—a method of using the cloud chamber in which the expansion is initiated by the passage of the particle to be photographed. This has proved to be a most valuable instrument. This work led immediately to the detailed study of cosmic ray particles; and Blackett and Occhialini found, almost at the same time as Anderson, that positively charged particles of electronic mass occur in the cosmic rays. With Chadwick and Occhialini, Blackett showed the formation of positrons by the passage of hard gamma rays through lead. Since that time Blackett has concentrated almost entirely on the subject of cosmic rays. He has initiated investigations at Cambridge, at London (Birkbeck College) and at Manchester; indeed most of the experimental work on cosmic rays in Great Britain has been inspired by him more or less directly. His own work has been chiefly concerned with the energy spectrum of the particles, which he has investigated by means of a very refined cloud chamber in a strong magnetic field.

Prof. D. R. R. Burt

MR. DAVID R. R. BURT, who has just been made professor of zoology in University College, Colombo, has had charge of his department since 1924, and has raised it from small beginnings to a school of more than a hundred students. Prof. Burt is a graduate of St. Andrews, and was at one time an assistant to Sir D'Arcy Thompson; he also worked under Hans Przibram in Vienna. He has studied, among other things, the very numerous cestode parasites of the Ceylon fauna. Some years ago he devised, and described in NATURE, a method of anatomical injection with rubber-latex which has great advantages and has come into everyday use, especially in America.

Centenary of Sir Hiram Maxim

AMONG the great mechanical inventors of last century, none was known to a wider public than Sir Hiram Maxim, who was born on February 25, a century ago. When he came to Europe in 1881 to attend the Paris Exhibition, he was the engineer of the first electric light company in the United States, but was known to few in Great Britain. He had, however, already taken out a goodly number of patents, had invented a gas-making machine for lighting buildings and had done much original work on the incandescent electric lamp, dynamos, regulators, boiler plant and suchlike. When on the Continent, his attention was attracted to the subject of machine-guns. His countrymen Gatling, Gardner, and Hotchkiss had all invented machine-guns, and so had the Swedish engineer Nordenfelt. None of their guns, however, had proved entirely satisfactory.

In Paris Maxim drew the design of his gun, and his original gun was made in a workshop at 57A Hatton

(*Continued on page* 299)

NATURE

SUPPLEMENT

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SHORT REVIEWS

BIOLOGY

(1) Bacteriology
For Medical Students and Practitioners. By Prof. A. D. Gardner. (Oxford Medical Publications.) Second edition. Pp. viii+274. (London: Oxford University Press, 1938.) 6*s*. net.

(2) The Microscope Made Easy
By A. Laurence Wells. Pp. 182. (London and New York: Frederick Warne and Co., Ltd., 1938.) 3*s*. 6*d*. net.

(1) PROF. GARDNER has managed to include in this small book a surprising amount of information on bacteriology, which is adequate for the medical practitioner who desires to keep abreast of advances in the subject, as well as being detailed enough for the medical student, with some supplementary reading. The matter is well presented and readable, singularly free from errors, and well up to date. Apart from the descriptions of the pathogenic micro-organisms and their effects, such subjects as immunity and antibody-antigen reactions, agglutination and anaphylaxis, and bacterial variation, are particularly well done, and the author has managed to include short sections on disinfection and the bacteriology of water and milk. The additional chapter on viruses in this second edition gives an excellent general account of the subject, together with sections on microscopical visibility and the bacteriophage. This is a book that can be cordially recommended.

(2) Mr. Wells's book, as its title implies, is a simple guide to elementary microscopy. The descriptions are easy to follow, and accounts are given of the microscope, and how to examine and mount a number of objects—crystals, pond life, diatoms, etc. The book contains several plates which satisfactorily illustrate and name a number of the objects mentioned in the text. The beginner without previous knowledge of microscopy will find it a useful first book on the subject. R. T. H.

The Fauna of British India, including Ceylon and Burma

Edited by Lt.-Col. R. B. S. Sewell. (Published under the Patronage of the Secretary of State for India.) Butterflies. Vol. 1. By G. Talbot. Pp. xxix+600+3 plates. (London: Taylor and Francis, Ltd., 1939.) 35*s*.

SINCE the publication of Bingham's volumes in the Fauna of India series in 1905 and 1907, knowledge of Indian butterflies has progressed very considerably. The issue of new volumes on these insects is, therefore, justified. In the present book there is a general and rather elementary introduction to certain aspects of the subject as a whole. External characters, variation, mimicry and distribution are dilated upon in this chapter: the rest of the volume is devoted to accounts of the species belonging to the families Papilionidæ and Pieridæ and, whenever possible, descriptions of the early stages are included.

The present work is uniform with the other volumes in the series and maintains the standard already established by its predecessors. It is a book which all who wish to know about Indian butterflies will need to consult. Some time will evidently elapse before the work is brought to completion by subsequent volumes, since only about one seventh of the recognized species are dealt with in the present contribution.

The Structure of Economic Plants

By Prof. Herman E. Hayward. Pp. x+674. (New York: The Macmillan Company, 1938.) 22*s*. net.

THIS volume is an outgrowth of the author's courses in plant anatomy at the University of Chicago. It is divided into two parts, the first dealing with general plant anatomy, and the second with the structure of a selection of plants of economic value. These are chosen partly for their economic importance, partly as typical representatives of the various families, and partly for their anatomical complexity. Fruit crops are omitted, as the author plans a second volume devoted especially to them.

Part 1, consisting of 109 pages, is an excellent condensed introduction to vegetable anatomy. In Part 2, the structure of the selected crops is treated in detail and full references to literature are given. It is, in effect, a series of monographs, and should prove very valuable to any research worker who requires an account of the basic anatomical structure of the plant he is dealing with. A special feature is the number of diagrams showing the course of vascular bundles in stems and other structures. Throughout the book the copious illustrations are, with one or two exceptions, clear and well drawn.

In matters not purely anatomical, the author's high standard is not always maintained. For example, in the discussion of the hybrid origin of 'Grimm' and other variegated alfalfas, the important genetical work of Urban (1877) and others, which puts this origin beyond doubt, is not mentioned. In the glossary, phylogeny is defined as "the developmental history of a race rather than an individual"; it would surely be preferable to substitute a broader term, such as 'group', for 'race', which has a too restricted connotation.

L'Acide ascorbique dans la cellule et les tissus

Par Prof. A. Giroud. (Protoplasma-Monographien, Band 16.) Pp. vi+187. (Berlin: Gebrüder Borntraeger, 1938.) 12 gold marks.

IN this monograph—the sixteenth of the well-known "Protoplasma" series—Prof. A. Giroud develops, from an account of his own and other histochemical studies on the distribution of ascorbic acid in plant and animal cells, an interesting general discussion of the biological function of the vitamin. Although his treatment is sometimes rather speculative and often superficial, it provides a highly stimulating review of the large literature that has grown up since Szent-Györgi announced the discovery of 'hexuronic acid' ten years ago. It well repays reading. J. C. D.

CHEMISTRY

A History of Chemistry

By Dr. F. J. Moore. Revision prepared by Prof. William T. Hall. (International Chemical Series.) Third edition. Pp. xxi+447. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20*s*.

IN this revised edition of a well-known and valued work, the account of the earlier period has been greatly extended and new material has been added in most parts of the text. A valuable feature of the book is the attention given to American chemists; it is not generally known, for example, that Crafts was an American, although much of his work was done in France. The history is brought down to recent times, although some of the sections dealing with atomic structure are now in need of revision, and the statement on p. 406 as to the possible future use of the electron theory in organic chemistry needs rewording, in view of the extensive applications which have been made in this field. The text is very accurate and very few slips have been noted; among these is the statement on p. 337 that Mitscherlich was Russian, and the name Rausch on p. 429 for Ruark. The book is most attractively written and displays a truly philosophical outlook throughout; the new edition may be cordially recommended both to students and also the general reader. The large number of interesting illustrations should be specially mentioned.

Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L. Wolf. Band 10, Abschnitt 3: Starkeffekt, von B. Mrowka; Elektrischer Kerr-Effekt (Elektrische Doppelbrechung), von H. A. Stuart. Pp. 110+vi. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 12 gold marks.

THE first twenty-six pages are devoted to the Stark effect. This brief article will prove useful alike to physicists and physical chemists. It is written in a clear, straightforward style. After dealing with the Stark effect of hydrogen atoms and helium ions, consideration is given to the Stark effect of helium atoms, of atoms with more than two circum-nuclear electrons, and of molecules. The article concludes with a treatment of the relationship between the Stark effect and other phenomena.

All who are interested or engaged in problems of molecular structure will welcome Dr. Stuart's capable summary of the electro-optical effect first observed by Kerr in 1875 and named after him. A discussion of the theoretical aspects, occupying twelve pages, is followed by an account of the methods used in the investigation of the effect. Various factors which influence the effect are discussed and the magnitude of the influence of each is indicated. The last thirty pages illustrate the application of Kerr effect data to problems of molecular structure. Tables of selected reliable data and an extensive bibliography are given.

Both articles are treated in a clear, competent manner and can be recommended to all interested in these topics.

Inorganic Chemistry

By Fritz Ephraim. Third English edition. By Dr. P. C. L. Thorne and Dr. A. M. Ward. Pp. xii+912. (London and Edinburgh: Gurney and Jackson, 1939.) 28*s*. net.

IN preparing the new edition of this well-known book, the editors have made a number of useful additions covering recent work and have revised several parts of the text. There are still some parts of the old text which should be removed, as they are in contradiction with the new material. The point of view is more modern than was the case in previous editions, particularly in the sections dealing with co-ordination compounds, and the book is certain to maintain its well-deserved popularity with advanced students. It provides a very good survey of modern inorganic chemistry in a reasonable compass, and the references to the literature will enable both teachers and students to amplify the information on any particular subject. The printing and lay-out are very good and the book is pleasing in appearance; the price is very reasonable.

GEOGRAPHY AND TRAVEL

Transport in Many Lands

By W. Robert Foran. Pp. 260. (London and New York: Frederick Warne and Co. Ltd., 1939.) 7*s*. 6*d*. net.

MR. FORAN'S "Transport in Many Lands" is not, as its title may seem to suggest, a systematic account of the various methods of transport practised by different peoples, but to the general reader it will probably prove more entertaining. It is a record of personal experience and observation, more especially in the indulgence of a personal preference for animal transport, in the course of some forty years of travel in many of the remoter quarters of the globe. The elephant holds pride of place, both as a worker in the teak forests of the East, and as an impressive member of the pageantry of eastern princes. Some of the instances of its intelligence when logging timber are indeed, as the author describes them, almost 'uncanny'. Next to the elephant comes the camel, which as Mr. Foran points out, when discussing ancient trade routes, is one of the most ancient forms of animal transport on an economic scale employed by man. One of the most surprising uses, to which the author has put it, is as a mount for polo in Egypt. Apparently the experience was enjoyable. Following on the llama in South America and yak in Tibet, Mr. Foran deals with pack animals, the horse, mule and donkey, and then reindeer, oxen, and dogs, concluding with a chapter devoted to some of the strange vehicles and methods of transport he has seen, in which the power of man himself is harnessed. It is perhaps scarcely necessary to point out in reference to Mr. Foran's account of the reindeer that the Samoyedes and Ostiak of Siberia are not Eskimo.

In his forty years of observation Mr. Foran has witnessed a vast extension of European methods of transport among backward peoples in the use of the car and the bicycle. Nevertheless he shows how, under the influence of environment and tradition, old-fashioned methods still in many regions maintain their vitality, and usually for good reason.

L'Asie centrale soviétique et le Kazakhstan

Par Charles Steber. Pp. 302. (Paris: Éditions Sociales Internationales, 1939.) 35 francs.

THE part of Central Asia formerly known vaguely as Russian Turkestan and now comprising several autonomous republics of the Soviet Union is little known and is treated mainly in books which lack recent information. For the main part, it is an area of vast and somewhat arid plains extending southward from Siberia and eastward from the European plain, but it comprises also the mountainous little explored area in which lie much of the Pamirs and allied ranges. Formerly it was a land of sparse population and nomadic tribes, but all that is changing. Soviet influence has begun to develop its resources on a large scale. Irrigation, where possible, has led to agriculture, and the cotton output, not to say its manufacture, is already considerable. Public works, roads, railways and schools have been built, and even in the remoter mountain areas Russian influence is spreading. The author of this small but informative volume gives a clear record of the land and its progress, although his physical introduction is somewhat brief. There are simple but adequate maps and many references to authorities.

GEOLOGY

Elements of Geology

With Reference to North America. By Prof. William J. Miller. Second edition. Pp. x+524. (London: Chapman and Hall, Ltd., 1939.) 21*s*. net.

ALTHOUGH prepared primarily for American students, Prof. Miller's text-book is written in such a simple and interesting style and is so well illustrated that it should have a wide appeal. Indeed, the author arouses interest in the science at the outset, for he takes the novel course of describing, in his opening chapter, the evidence for upward and downward movements of the earth's crust and the phenomena of earthquakes—both subjects not too remote from everyday life. Thence he leads the reader to the study of minerals and rocks, weathering, rock-structure, and the work of rivers, glaciers, wind, the sea, underground water, and volcanoes. The development of scenery is also simply described. Having regard to the vast accumulation of data relating to these subjects, every author of a text-book must decide what to omit: and here Prof. Miller's selection seems to have been judicious.

The second half of the volume is concerned with historical geology and, except for the penultimate chapter on Cenozoic life, has reference only to North America. Dull stratigraphical details are avoided so far as possible and full use is made of palæogeographical maps. The section on early man in the chapter on Cenozoic life has necessarily, however, been largely compiled from the records found in the Old World, and here the author is rather less happy in his summary than elsewhere in the book. A study of articles recently published in NATURE would afford him material help, and the author might find it worth while to seek the assistance of some geological and archæological friends in Europe in wending his way through the tangle of conflicting accounts of the history of man. The volume is of such quality as to justify the effort.

Ground Water

By Prof. C. F. Tolman. Pp. xvii+593. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36*s*.

THIS book makes a notable addition to the literature of ground-water hydrology. The author assumes the reader to possess an elementary knowledge of geology and of hydraulic engineering, and the introductory historical chapter mentions the importance of co-operation between geologist and engineer in the study of sub-surface waters. Chapter ii states the general principles controlling the occurrence and behaviour of ground-water, with terms defined, and is intended to provide a summary suitable for the lawyer preparing litigation on the subject; numerous page-references are given in the index under the general heading 'Litigation'. Chapters follow with a detailed discussion of rainfall, porosity, soils, flow of ground-water, and the water-table, the last containing a 24-page appendix on prospecting for water by geophysical methods, contributed by C. A. Heiland.

Selected references to literature (mainly American) are given at the end of each chapter. Water in fractures, artesian supplies, wells, oil-field fluids, and springs form the subjects of further sections. The last two chapters deal respectively with quantitative methods of measurement (with extracts from publications by O. E. Meinzer) and the distribution of underground water in the United States and the Hawaiian Islands. The book is illustrated by 189 good text-figures; most of the water-table contour maps in Chapter ix lack a statement of scale, which would have been helpful in estimating water-table gradients. There is a useful glossary of more than a hundred terms and a generous index.

MATHEMATICS

An Introduction to Modern Statistical Methods

By Paul R. Rider. Pp. ix+220. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 13*s*. 6*d*. net.

THIS text-book on statistical methods is intended for the student who is interested in applications, but who at the same time, while not aiming at a complete knowledge of the underlying mathematical theory, would like to get a grasp of the main principles and formulæ. It is thus introductory both to theory and application, and although the discussion sometimes seems more fragmentary than one would wish, the author has welded the two aspects together into a fairly unified course.

The statistical concepts of frequency distributions, averages and moments, regression, and correlation, are first explained, before sampling and significance problems are dealt with. After a chapter on the binomial and normal distributions, the author then discusses the use of "Student's" and the χ^2 distributions, before concluding with the general principles of analysis of variance and experimental design. Statistical tables required for significance tests are included at the end of the book, and appended to each chapter is a useful collection of examples. It should be noted that in his discussion of the χ^2 test of goodness of fit (p. 108), the author omits to warn the reader of the necessity for *efficient* estimation of unknown parameters; in fact, the whole problem of estimation, even for an introductory text-book of this kind, seems scarcely adequately discussed. M. S. B.

An Introduction to the Theory of Functions of a Real Variable

By S. Verblunsky. Pp. xi+170. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 12*s*. 6*d*. net.

TO the ordinary mathematical student, geometrical illustrations in a text-book on analysis are a relief and an inspiration; to the purists the use of figures is a weakness. They demand that the theory shall be based on arithmetical considerations alone. Mr. Verblunsky's treatise completely satisfies this demand. For the student of analysis who is already acquainted with the subject, a careful reading of this book should be a useful discipline in careful and logical statement. For the usual type of honours student a course of this kind would, we fear, be disastrous.

The volume starts at the beginning of the subject—with the positive integers—and leads on by carefully graduated steps to the study of functions, sequences, derivatives, limits and integrals, closing with a chapter on infinite series. There are numerous illustrative examples, most of them fully worked out; but no sets of examples for practice are provided.

Mr. Verblunsky's exposition is, in the main, clear, concise and accurate. We deprecate, however, his method of introducing irrational numbers. This he bases on the following "Postulate of the Continuum". If, for every n,

$$a_n \leqq a_{n+1} \leqq a_n + (\tfrac{1}{2})^n,$$

then there is just one number ξ such that, for every n,

$$a_n \leqq \xi \leqq a_n + (\tfrac{1}{2})^{n-1}.$$

This postulate is flung at the reader with practically no explanation or discussion. The effect on the beginner is bound to be bewildering. If the book is to be used as a text-book it will be necessary for the teacher to lead up to the postulate by some sort of explanatory introduction.

MEDICAL SCIENCE

Medical Entomology

With Special Reference to the Health and Well-being of Man and Animals. By Prof. William B. Herms. Third edition, based on the book known as "Medical and Veterinary Entomology". Pp. xx+582. (New York: The Macmillan Company, 1939.) 24*s*. net.

WITH the present volume, and those by Matheson and by Riley and Johannsen, the student of medical entomology is very well catered for in North America. Prof. Herms has, in this book, brought out a complete revision of his "Medical and Veterinary Entomology", the second edition of which appeared in 1923. Since that time an enormous amount of information has accumulated. Its sifting and compression, necessitated in a book of this kind, is no light task, and Prof. Herms has accomplished the feat with notable success.

All the more important diseases and other affections of man, and of domestic animals, in which insects and arachnids are implicated as carriers or as causative agents, come in for discussion. In addition to six chapters of a more or less general character, some fourteen chapters are devoted to insects in relation to disease, two chapters to arachnids in the same connexion, together with a chapter on venomous and urticarial arthropods and a final one dealing with the utilization of arthropods in medical practice.

Written in a clear, terse style, a great deal of valuable information is compressed in rather fewer than 600 pages. Prof. Herms's book can be confidently recommended as an up-to-date guide to its subject.

The Genuine Works of Hippocrates

Translated from the Greek by Dr. Francis Adams. Pp. ix+384+8 plates. (London: Baillière, Tindall and Cox, 1939.) 13*s*. 6*d*.

THIS volume appears to be a reproduction in book form of Francis Adams' translation for the Sydenham Society in 1849, which Dr. Emerson Crosby Kelly, the editor, had already published in *Medical Classics* for September, October and November, 1838. It contains the following works of Hippocrates which Adams regarded as genuine: The Oath, On Ancient Medicine, On Airs, Waters and Places, On the Prognostics, On Regimen in Acute Diseases, First and Third Books of the Epidemics, On Injuries of the Head, On the Surgery, On Fractures, On the Articulations, Mochlicus, Aphorisms, the Law, On Ulcers, On Fistulæ, On Hæmorrhoids, and On the Sacred Disease. The present edition has the advantage over the Sydenham Society's publication in consisting of only one volume instead of two, but this has been effected by the omission of (1) Adams's Preliminary Discourse, which deals with the life of Hippocrates, his disquisition on the authorship of the different treatises attributed to Hippocrates, and the physical philosophy of the ancients, (2) Adams's introductions to the various treatises contained in the volume, and (3) almost all the footnotes as well as a considerable number of the entries of the index. The present edition, therefore, will be more acceptable to the general reader than to the medical historian, who will miss the learned commentaries of one of the most famous authorities in classical Greek medicine.

MISCELLANY

The Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland

With a Record of Publications issued during Session 1938–1939. Compiled from Official sources. Fifty-sixth annual issue. Pp. vii+175. (London: Charles Griffin and Co., Ltd., 1939.) 10*s*.

IN spite of the dislocation of the work of scientific and learned societies by the War, the publishers state in their preface to this useful reference book that they hope to continue to produce it. Indeed, in view of present difficulties, it is a matter for congratulation that the book has appeared so promptly, and that no increase has been made in the price. The volume is slightly larger than last year's issue, and contains the usual information relating to the addresses, publications and other activities of scientific and learned institutions, including such official bodies as the Department of Scientific and Industrial Research. In many cases the bodies referred to will no doubt have war-time addresses, but it may be assumed that correspondence addressed to their permanent homes will eventually reach them.

The Theory and Practice of General Science

By H. S. Shelton. Pp. 123. (London: Thomas Murby and Co., 1939.) 3*s*. 6*d*. net.

MR. SHELTON'S book is written chiefly in support of a detailed syllabus of general science, which he has arranged in the form of topics, and it may be said at once that the syllabus is a good one. He himself seems to be in no doubt about it, for he writes: "To those who desire to found a course of general science, it can be said quite simply and clearly: Here it is for the first time in a simple, intelligible and coherent form". Mr. Shelton is severely critical of all other syllabuses of general science, especially those which have recently been compiled by the Science Masters' Association. He seems, however, to have misunderstood their aim, which was not to mark the end of thought, but to display a content of teaching material which masters could employ in arranging their own schemes of work. For this purpose, the form in which the S.M.A. printed its material is more useful than Mr. Shelton's, since it can be adapted more easily to special circumstances.

Outlines of the History of Architecture

Part 4: Modern Architecture, with particular reference to the United States. By Prof. Rexford Newcomb. Pp. xv+318. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 20*s*. net.

IN the history of architecture class at the University of Illinois, Prof. Rexford Newcomb found it necessary to devise means whereby both lecturer and students could make full use of their opportunities. In these courses, which are largely presented by the illustrated lecture method, the students were compelled to write almost continuously in a darkened room, and much of the consequent distraction from the subject itself was obviated by supplying them with mimeographed sheets giving bibliographies, references, class assignments and directions—in fact, all the routine notes the writing down of which has no exercise value. From these sheets this very unusual book has been developed, and the author has done well to preserve and publish the valuable digest of the facts and examples on which his lectures were based. The fourth volume of the series is concerned with modern architecture—say from the beginning of the eighteenth century—and while American architecture is more freely referred to, historical, bibliographic and other data are collated from France, Great Britain, Germany, the Low Countries and Scandinavia.

PHYSICS

Electricity and Magnetism

An Introduction to the Mathematical Theory. By Prof. John B. Whitehead. (Electrical Engineering Texts.) Pp. xi+221. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 19*s.* 9*d.*

THE professor of electrical engineering of the Johns Hopkins University has written a compact introduction to electricity and magnetism in which stress is laid on the physical and mathematical theories. The historical order is adopted, and the first six chapters are concerned with electrostatics. A single chapter on magnetism is followed by chapters on electrodynamics and electromagnetism, and the electrical units receive special attention. The chapters on alternating currents are of value and deserve mention, as they include an elementary account of modern methods of computation. Finally, a brief description is given of the theory of conduction in gases. To condense so much into little more than two hundred pages is a noteworthy feat, and the author is to be congratulated on his presentation of the subject.

Matter, Motion and Electricity

A Modern Approach to General Physics. By Henry De Wolf Smyth and Prof. Charles Wilbur Ufford. Pp. xiii+648. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 25*s.*

UNIVERSITY teachers of physics who are not fettered by examination requirements and can plan their own courses will find this stimulating volume suggestive and helpful. Designed for a first-year course at Princeton, the book does not profess to cover the whole range of physics; but it deals with subjects related to the great theme of atomic and molecular constitution. It will therefore appeal to the chemist as well as to the eager student who wishes to plunge at once into the latest results of modern research on the properties of matter and of electricity. The advantages of the practical electrical units are so great that the authors have been led to adopt from the outset the M.K.S. (metre-kilogram-second) system of units.

Cosmic Rays

Three Lectures, being the revision of the 1936 Page-Barbour Lectures of the University of Virginia and the 1937 John Joly Lectures of Trinity College, Dublin. By R. A. Millikan. Pp. viii+134+22 plates. (Cambridge: At the University Press, 1939.) 8*s.* 6*d.* net.

THE first and perhaps the most important lecture is of a general character, in which, together with an account of the historical development of the subject, Millikan provides an answer to the often recurring question: What good are cosmic rays? He discusses the supreme social importance of abstract scientific knowledge, first in its applications to everyday life, although these may be delayed for generations, secondly in providing the example of a network of established fact to such subjects as economics, politics, etc.

The second lecture is an account of the various particles—positive and negative electrons, protons, photons and mesotrons, and of their discovery. It is noteworthy that throughout the book there is no mention of the instability of the mesotron, nor except in a footnote of its theoretical importance.

The last and longest lecture is a study of the latitude effects, both at sea-level and high in the atmosphere. It is valuable in giving in one place a full account of all the work of Millikan and his collaborators in this field, but is somewhat confusing reading, especially to those unfamiliar with the subject, as the historical development is given in detail. All the misconceptions, difficulties and mistakes of the past are treated with equal emphasis as the extent of our present knowledge.

PSYCHOLOGY

General Psychology

By J. P. Guilford. Pp. xii+630. (London: Chapman and Hall, Ltd., 1939.) 18*s.* net.

THIS book is divided into six parts. The first contains a discussion, on traditional lines, of the scope of the subject and a brief outline of the nervous system. A thorough and highly satisfactory section follows dealing with sensory activities and the processes of attention. The chapters on vision and hearing are noteworthy. The remainder of the book deals with the following topics: motivation of behaviour; acquiring new adjustments; symbolic activity, that is, images, concepts and language; and individual differences in ability and personality. The weakest chapters are those on human personality, which do not reach the standard set by the rest of the work.

The book is designed as an introductory experimental text, and each chapter concludes with a series of questions planned to test the student's grasp of the chapter. There are numerous diagrams and graphs, and the material is presented with clarity and simplicity. The student of psychology in Great Britain will welcome this interesting and up-to-date exposition of his subject.

The Mind of the Bees

By Julien Françon. Translated by H. Eltringham. Pp. xi+146. (London: Methuen and Co., Ltd., 1939.) 6*s.* net.

THIS little book is a reliable translation of "L'Esprit des Abeilles," the author of which is an original investigator and a good observer. His work has been carried out on foraging bees and not on bees within the hive. He appears, however, to under-estimate the importance played of odours in bee-behaviour, and claims that the first-comer communicates the location of a food source to the other foragers, who are thus enabled to find it. These and many other observations are carried out in a scientific manner, but the deductions made therefrom are more open to criticism. In spite of whatever defects the book may have, it is suggestive and well worth reading.

Garden, London. In it Maxim used the force of the explosion to work the breech mechanism, and for the first time produced a fully automatic gun. The Maxim Gun Company was formed in 1884 and soon it was supplying guns to many armies. In the 'nineties Maxim began his experiments with steam-driven 'captive' flying machines, on which he spent many thousands of pounds. He knew he was trying to achieve something thought impossible, and if he had little success he at least brought the subject of aeronautics into the limelight. Scores of distinguished men, including King Edward VII, then Prince of Wales, visited Baldwyns Park in Kent and rode on Maxim's machine.

Like Edison, Maxim had but little schooling, but became a first-class mechanic and pored over such books as Ure's "Dictionary of the Arts". In middle life a short handsome man of great strength, he was as self-reliant as Ericsson and as fruitful in ideas as Trevithick and Bessemer. Traditional views were nothing to him, and, though he made himself familiar with what others had done, he looked at every problem in his own original way. He was born in the State of Maine, U.S.A., but after his visit to Europe he made his home in England, became a naturalized British subject, and in 1901 was knighted. He died on November 24, 1916, and was buried in Norwood Cemetery.

William Smith

At a meeting of the Geological Society of London on January 17, Dr. L. R. Cox, of the British Museum (Natural History), delivered a lecture on the life and work of William Smith, the Father of English geology. The subject was chosen for two reasons, one being that this was the session of the Society nearest to the centenary of Smith's death, and the second that Dr. Cox had recently had an opportunity of studying Smith's original notes, diaries and letters, which have not hitherto been made public. These MSS. have apparently lain unexamined at Oxford for many years, presumably since the death of John Phillips, Smith's nephew, who until his death in 1874 occupied the chair of geology there. They were recently discovered in Oxford in a packing-case by Prof. J. A. Douglas, the present occupier of the chair, and through his courtesy they have since been examined systematically by Dr. Cox. They are now catalogued and housed in a specially built cabinet presented by Dr. K. S. Sandford and Mr. H. A. Sandford.

There are many gaps and obscure passages in the existing records of Smith's life, and these manuscripts throw a flood of light on the activities of this great geologist. Apart from the outstanding importance of his contributions to geological science, Smith lived during the heroic age of geology. The MSS. have therefore a more than personal interest, and should contribute materially to the history of the science during this period. The only existing biography of Smith, Phillip's "Memoirs of William Smith, LL.D.", has long been out of print and is almost unprocurable. With the new material at his disposal, there is every reason for Dr. Cox to prepare a full-dress account of the life and work of so worthy a subject, and it is to be hoped that its publication may not be unduly delayed.

Treasury Grant to Universities

It has been decided to maintain the Government Grant to the Universities and Colleges at the existing level, namely, £2,149,000. In reply to a question in the House of Commons on February 20, Sir John Simon said: "The Government are fully conscious of the vital part played by the universities in the life of the community, and of the importance of maintaining the standards of university education as far as possible in the strained conditions of war. Moreover the universities are making an essential contribution to the national effort at the present time in supplying personnel of the educational standards necessary for many national services, as well as in affording more direct assistance to a number of Government Departments by means of particular researches, the provision of specialized technical equipment in laboratories, and in other ways. I have satisfied myself, after considering the representations of the Vice-Chancellors and the results of a survey of university finance carried out at my request by the University Grants Committee, that the maintenance during the coming financial year of the present provision is necessary if the universities are to continue to make their contribution to the national effort, and the Government therefore earnestly hope that local authorities will take similar action."

British and French Scientific Co-operation

In connexion with the recent visit of the French scientific delegation, Capt. D. F. Plugge, chairman of the Parliamentary and Science Committee, asked the Minister of Supply what arrangements had been made for regular liaison between French scientific representatives and the Advisory Council on Scientific Research and Technical Development. Mr. Burgin made the following written reply: "Regular liaison between the Advisory Council referred to and French scientific representatives is effected through the Mission Scientifique Franco-Britannique, which has a permanent Secretary resident in London, who will shortly be located in the Ministry of Supply. The Mission has contact with the whole of the French war-time scientific organization. There is, in addition, a direct link between the Ministry of Supply and the French Ministère de l'Armement, which can be used by the Advisory Council for matters relating to scientific inventions, in the form of a Ministry of Supply officer who has been appointed liaison officer in the French Ministère and will shortly take up his duties in Paris."

Physics in War

A SERIES of public lectures on the "Background to Present-Day Problems" has been arranged in the University of Birmingham. The second lecture in this series was given by Prof. M. L. E. Oliphant, Poynting professor of physics in the University. His subject was "Physics in War". Prof. Oliphant stressed the value of academic science, which in present circumstances can be turned to practical use. Future development of industry depends on the academic development of science, which in Great Britain is conducted only in the universities. It is therefore essential that the country should encourage academic research in science if we are to keep any sort of supremacy in industry. So far, the War has been almost entirely a physicists' war, waged with weapons depending for their operation on knowledge gained by physicists.

Prof. Oliphant referred to the great value of the pioneer work done by Dr. Lanchester in aviation, to the work of Sir William Bragg and Lord Rutherford on the detection of submarines, and to the development of the high-class optical industry. 'Wireless' is proving to be the fundamental controlling factor in the present War, and perhaps, when it is over, the public will realize how great is the work done by physicists in this field. The control of the magnetic mine presents no difficulties to the physicist. Scientific and technical men sometimes complain that they have not been given any job, and that their talents are not being used. Some of this criticism is justified, Prof. Oliphant said, because in England there is a tendency to allow administrative offices to be filled only by persons with non-technical qualifications. He deplored the conclusion that is sometimes reached that because a man has technical qualifications he cannot discharge administrative duties.

Censoring Scientific Journals

IT is announced that, at the request of Sir Walter Monckton, director-general of the Press and Censorship Bureau, Sir William Bragg, as president of the Royal Society, has undertaken the formation of a scientific panel to assist the bureau in arranging the censorship of papers in scientific journals. The following have agreed to serve on the panel: Prof. C. R. Harington (biochemistry), Prof. V. H. Blackman (botany and agriculture), Prof. A. C. Egerton (chemistry), Dr. H. L. Guy (engineering sciences), Prof. P. G. H. Boswell (geology), Prof. S. Chapman (mathematics), Dr. C. H. Desch (metallurgy), Dr. C. G. Darwin (physics), Prof. A. V. Hill (physiology), Prof. F. C. Bartlett (psychology), Prof. W. W. C. Topley (bacteriology and pathology), Prof. M. Greenwood (statistics), Sir Guy Marshall (zoology).

Animals and Plants of Use to Man

THE British Museum (Natural History) is now open to the public on Saturdays and Sundays from 1 p.m. until 4 p.m. A special exhibition has been arranged in the Shell Gallery to show the animal and plant sources from which some useful commodities come. This is too vast a field for the exhibition to be an exhaustive one, consequently only selected exhibits, illustrating commodities which lend themselves to attractive demonstration, are shown. These include the sources of certain textiles like linen, cotton, silk and rayon; plant and animal dyes used in commerce; the colouring matter and ingredients of cosmetics; the sources of leathers and of bristles for brushes; the plants and animals which produce oil in large enough quantities for it to be valuable to mankind; and some of the uses of moulds and mushrooms. Several of the cases have a war-time interest; for example, animals of use in war, margarine, bacon pigs, pests of stored food. The object of the exhibition is to show the sources of certain commodities, and not to give a detailed explanation with examples of how the raw materials are worked up into the finished products.

Discovery of a Royal Tomb in Egypt

A FURTHER discovery reported from San-el Hagar, the ancient Tanis, in the Nile Delta, promises results of even greater interest than those anticipated from the examination of the remarkable gold and silver sarcophagus discovered on this site by Prof. E. Montet, of the University of Strasbourg, in March of last year (see NATURE, 143, 512 and 552). When Prof. Montet returned to Egypt about a month ago to reopen his season's work on the tombs of the Twenty-first and Twenty-second Dynasties on this site, he proposed to examine the sarcophagus which had been left unopened. The cartouche of Pharaoh Psussenes, identified with Sheshonk, had led to the attribution of the sarcophagus to that monarch; but in the course of the work of further examination, another tomb, it is reported (*The Times*, February 20) has been brought to light, which is thought to be the royal tomb, while the gold and silver sarcophagus is now said to be that of a royal priest. The newly discovered tomb contains a huge granite sarcophagus and a profusion of funerary ornaments. These consist for the most part of gold vessels, and include a gold cup in the form of a lotus, which is said to be of great beauty. This is the first royal tomb of the period (*c.* 1100–1000 B.C.) to be discovered; and it is of enhanced importance as belonging to a phase of Egyptian dynastic history of which archæologically too little is known.

Statistical Methods and Ethnographical Observations

A NUMBER of attempts have been made from time to time to introduce statistical methods of analysis in the study of ethnographical facts, but certain obvious difficulties, more especially the artificial abstraction and the divorce of so complex an entity as an ethnographical fact from its cultural context, as a rule have militated against extended and continued application of these methods. Anthropologists, therefore, have watched with considerable interest the work of the Culture Element Survey of Native North-West America of the University of California, of which Prof. A. L. Kroeber is director. This survey was initiated as a result of an attempt to apply statistical methods of analysis to the recorded ethnographical data concerning the Indians of California by S. Klimek, who went to the University in 1933 as a Rockefeller Fellow.

The Survey has now become the most considerable example extant of the application of statistical technique to ethnographical observation. Prof.

Kroeber, in a progress report covering the work of the Survey to April, 1939 (*Anthropological Records*, 1: 7, Culture Element Distributions, 11, 1939, University of California Press), records that between 1934 and 1938 twenty trips to indigenous groups of peoples were made by 13 different observers, who brought back 279 filled-in lists of elements. In these there are now at least half a million of particularized and localized items of cultural fact, or if the supplemental notes are included, the number may well be nearer a million. Although several monographs already have been published, the great bulk of this material awaits computation. Not only does this task seem beyond human capability as a practical method of comparative ethnographic study, but also Prof. Kroeber now records that experience in the field, as well as in the study, counsels a reversal of method, at least to a major degree, in a return to the observational records of the more orthodox ethnographer.

Anglo Soviet Journal

THIS new journal has been started with the purpose of supplying "the more scientifically skilled and specialized workers in the British Commonwealth with a regular flow of information, accurate and reliable, on the progress and developments that are being realized in the U.S.S.R., in their own field, the field which they understand best". Very wisely the first issue is largely devoted to accounts of exhibitions, particularly of the great Agricultural Exhibition held in Moscow last summer, which was unquestionably the most magnificent effort of its kind the world has ever seen. Dictatorships are based on propaganda, and the Russians are the acknowledged leaders of the world in this new art. The design of the Exhibition was coherent and logical: the products of each region were brought together into separate pavilions, and each of the chief products had also its own special arrangements for show. The architecture was impressive and striking: no one could possibly forget the huge statue at the gate or the tower just inside, or the beauty of some of the pavilions.

The visitors included parties of peasants, some in picturesque local costume from all parts of the Union; many of them saw their own photographs hung up as good workers who had achieved more labour days than their fellows. More attention was paid to records than to average performances. Special notice was given to the effort of two farm workers, Okhota and Chalova, in getting forty-one tons of sugar beet per acre (the average for England and Wales is about ten tons). How far the Exhibition reflects actual performance in the countryside cannot be determined, as no detailed statistics of yield or total production have been published so far as we know since 1935, though there are some figures for the bumper year of 1937: but that is not the question. A forecast is given of the results anticipated from the proposed Trans-Volga irrigation scheme which, if it matures, and is free from too much complication of water-logging and salt, should produce food in a region where but little is grown now.

France's Colonial Problems

IN an address on "The Establishment of an Imperial Economy" (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, October 1939), M. E. du Vivier de Streel discusses the dependence of France on her colonial resources. He stresses the importance of science and technology in colonial development and the necessity of placing larger resources at the disposal of scientific organizations and technical men for the investigation of colonial problems, whether in improvement of agriculture, the prevention or control of disease, or the opening up of mineral resources. Such work should not be left precariously at the mercy of any local drive for economy. M. du Vivier de Streel refers also to the importance of population questions, education and a policy of public works, but while covering briefly much the same ground as the "African Survey" of Lord Hailey, he makes no reference to that outstanding work.

Studentship for Psychical Research

TRINITY COLLEGE, Cambridge, has established a studentship for the study of psychical research, out of a bequest left to the College for that purpose by Mr. F. D. Perrott as a memorial to F. W. H. Myers. Psychical research is defined, for this purpose, as "the investigation of mental or physical phenomena which seem *prima facie* to suggest (*a*) the existence of supernormal powers of cognition or action in human beings in their present life, or (*b*) the persistence of the human mind after bodily death". The studentship is open to any person who shall have completed his or her twenty-first year at the time when the election takes place. The studentship is tenable for one year, but a student may be re-elected once, but not more than once. The studentship will be of such value, not exceeding £300, as the electors may award after considering the nature of the research which the candidate proposes to undertake. Further information can be obtained from Prof. C. D Broad, Trinity College, Cambridge.

January Earthquakes Registered at Kew

DURING January 1940 thirteen earthquakes were well registered by the seismographs at Kew Observatory. The largest of these were on January 6 at 14h. 23m. 2s. and January 17 at 1h. 33m. 24s., though a doubtful phase preceded this at 29m. 35s. This latter shock was registered at De Bilt (Holland) at 33m. 16s. G.C.T., and the shock of January 26 was also well observed there. The United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the epicentre of the earthquake of January 6 to have been lat. 22° S., long. 170° E. with initial time 14h. 3·4m. G.C.T. This determination was based on observations of seismograms obtained at Georgetown, Sitka, Apia, Honolulu, Pasadena, Fordham, San Juan and Manila. The provisional epicentre was in a well-known seismic zone of the Pacific Ocean to the east of the island of New Caledonia. The earthquake of January 17 was found by the same authority on the basis of reports from nineteen observatories to have been provisionally centred at lat. 17° N., long. 148° E., and to have had initial time 1h. 14m. 53s. G.C.T. This epicentre was in the Pacific Ocean to the east of Zealandia Bank (Marianas Islands).

The Night Sky in March

The time of the spring equinox is March 20 18h. when the sun enters the sign Aries. The moon is new on March 9 and full on March 23. Lunar conjunctions with the planets occur as follows: March 11d. 8h., Jupiter: 12d. 14h., Saturn: 12d. 23h., Venus: 14d. 0h., Mars. It will be seen from these times that the grouping of the bright planets is still a conspicuous feature of the western sky after sunset, although Jupiter is being lost to view as the month proceeds. On March 8d. 14h., Venus is in conjunction with Saturn, and on March 26d. 14h. with Uranus. Mars is in conjunction with Uranus on March 16. Neptune is in opposition on March 14, the distance from the earth being 2,716 million miles. The constellations of bright stars associated with winter evenings are now well westwards when the sky darkens after sunset. The regions of the sky which follows—Leo, Virgo, Ursa Major and Bootes—though less spectacular to the unaided eye, are of great interest on account of the rich fields of extra-galactic nebulæ. With small or moderate optical aid, there is also a number of interesting double stars well worth examining, including Castor (separation of components 3·6″), γ Leonis (4·0″), ξ Ursæ Majoris (1·7″), γ Virginis (5·7″), ζ Ursæ Majoris (14″) and ζ Herculis (1·1″). The last binary has a period of about 35 years and was discovered in 1782 by Sir William Herschel; the greatest separation of its components is 1½″. Under favourable conditions the Zodiacal Light may be seen after sunset during this month. On fine evenings when the moon is absent, it is also worth while looking for auroras, for in March occurs one of the semi-yearly peaks in auroræ frequency. [All times are given in Universal Time; subtract 1 hour from Summer Time.]

Announcements

The University of Oxford has decided to confer the honorary degree of D.Sc. on Dr. E. V. Appleton, formerly Wheatstone professor of physics at King's College, London, and Jacksonian professor of natural philosophy in the University of Cambridge. Dr. Appleton is now secretary of the Department of Scientific and Industrial Research.

Prof. A. L. Mellanby will deliver the Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers on March 15, at 6 p.m. The title of the lecture will be "Fifty Years of Marine Engineering".

The Herbert Jackson Prize for 1939 of the L.M.S. Railway has been awarded to Mr. H. I. Andrews, of the Engineering Section, Research Department, Derby, for his paper entitled "The Development of a Refrigerating Machine for Use on Trains".

The council of the Institution of Naval Architects has awarded the Premium of the Institution for the year 1939 to Mr. A. Nicholls, for his paper "The All-Welded Hull Construction of H.M.S. *Seagull.* The Wakeham Prize for 1939 has been awarded to Mr. A. Emerson, for his paper "The Effect of Shape of Bow on Ship Resistance (Part 2)".

Dr. Warfield T. Longcope, Baltimore, has been elected president of the board of directors of the Rockefeller Institute of Medical Research in succession to the late Dr. Charles R. Stockard.

The Alfred Denker Foundation Prize for 1939 has been awarded by the German Otorhinolaryngological Society to Dr. Lotar v. Hofmann, of Vienna, for a work on the influence of diseases of the ear and upper respiratory tract on the development of the infant and young child.

The Committee of the Physiological Society which was planning the Seventeenth International Congress of Physiology at Oxford in August 1941 under the presidency of Sir Charles Sherrington has decided, with regret, that the Congress must be postponed. Arrangements for the future will be made in consultation with the Permanent International Committee.

The Central Association for Mental Welfare, in co-operation with the University Extension and Tutorial Classes Council, will, if sufficient applications are received, hold a course on mental deficiency at the London School of Hygiene, Keppel Street, W.C.1, from April 8 to 20. The lecturers will include Dr. A. F. Tredgold, Dr. Henry Herd and Miss Lucy Fildes. Further information can be obtained from Miss Evelyn Fox, c/o University Extension Department, at the School of Hygiene.

A research scholarship of the value of £250 a year and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a committee of the Institution of Naval Architects, and it is hoped to make the first award in September 1940. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

A prize of £20 with a diploma is awarded annually by the Council of the Royal Asiatic Society for an essay on some selected subject. The object is to encourage interest in the history and civilization of the East among non-Asiatics. In order to increase the basis of interest, the Council has decided to offer alternative subjects for the next competition. The two subjects are: (i) "Compare briefly the British, French and Dutch Systems of Administration in the East"; (ii) "The Development of Modern Turkish Literature". An essay on either subject may be submitted, and must be in the hands of the secretary at 74 Grosvenor Street, W., by October 1 next.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

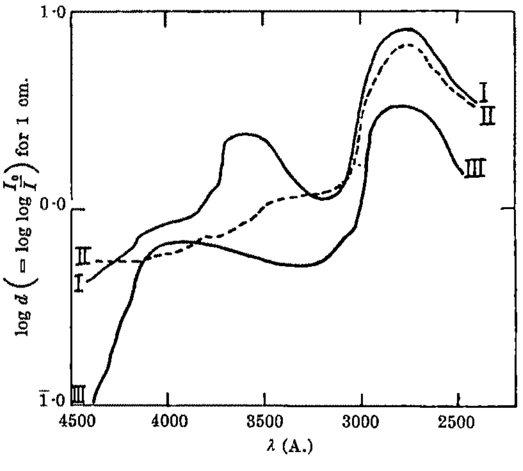
Notes on points in some of this week's letters appear on p. 308. Correspondents are invited to attach similar summaries to their communications.

Photo-Oxides of Carcinogenic Hydrocarbons

In a recent note under the above title[1], Prof. J. W. Cook described a number of water-insoluble peroxidic photo-oxides derived from carcinogenic hydrocarbons. Experiments made in Cambridge during the past year indicate that a photochemical oxidation product, which is different in character both from those prepared by Cook and from the alkali-soluble materials prepared by Boyland, can be obtained from 3 : 4-benzpyrene under suitable conditions. 10 c.c. of a 0·1 per cent solution of the hydrocarbon in benzene (B.D.H., 'Specially Pure') is irradiated for one hour in an open Petri dish placed three inches below a neon-sensitized mercury lamp of the type described by Melville[2], nearly all the energy radiated from which is concentrated in the 2536 A. resonance line. The remaining benzene is quickly evaporated off in a current of air, and the dry residue is extracted with 10 c.c. of glass-distilled water or with weak alkali ($M./500$ $NaHCO_3$) and filtered. The resulting solution is colourless—unlike the solid residue—and its absorption spectrum, I, contains two very well-defined bands, with maxima of intensity at about 3600 A. and 2760 A. respectively. When the aqueous solution is allowed to stand, the band at 3600 A. disappears, while that at 2760 A. becomes less intense, in the course of 3–4 hours, II. The spectrum is not of the dihydroanthracene type such as is that, for example, of the water-soluble endosuccinate derivative of 1 : 2 : 5 : 6-dibenzanthracene. It indicates, however, that a labile water-soluble photo-oxidation product can be prepared from 3 : 4-benzpyrene, even though this compound gives no photo-oxide of the peroxidic type. Schulman and Rideal[3] have shown that the labile constituent of the aqueous solution can be adsorbed readily on to protein monolayers. These observations may be correlated and compared with the experiments on the photodynamic activity of the hydrocarbons described by Mottram[4].

Benzene, irradiated under identical conditions, yields a small quantity of an oily residue which dissolves freely in water to give a clear yellow-coloured solution. The absorption spectrum of this solution, III, also contains a well-defined band at 2760 A.; but this is now associated with a very wide band the maximum of which is at about 3950 A., and the absorption curve passes through a *minimum* at 3600 A. This material cannot be identified with any of the usual impurities in benzene. The same result was obtained with highly purified specimens (i) obtained from the Bureau d'Etalons Physico-Chimiques in Brussels; (ii) prepared by the method described by Lowry and Allsopp[5]; and (iii) from B.D.H., 'Specially Pure', as used for the irradiation of 3 : 4-benzpyrene.

In preliminary experiments, embryonic chick heart has been grown for two passages (4–6 days) in a medium composed of fowl plasma and chick embryo extract to which had been added either (*a*) the aqueous extract from irradiated 3 : 4-benzpyrene, or (*b*) the aqueous extract from irradiated benzene. A high percentage of the mitotic cells in series (*a*) was abnormal, and prophase was prolonged, as compared with control cultures or with series (*b*).



(I am indebted to Dr. A. Glücksmann for making the cytological examination of these cultures.) It is concluded that the labile product from 3 : 4-benzpyrene may have high biological activity, and experiments to isolate the substance, to elucidate its chemical and biological nature and to determine the part played by the benzene solvent in its production, are in progress.

I am also indebted to Prof. E. K. Rideal and to Dr. H. B. Fell for much valuable advice and assistance.

C. B. Allsopp.
University Department of Colloid Science
and Strangeways Research Laboratory,
Cambridge.
Jan. 29.

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[1] Cook, J. W., Martin, R., and Roe, E. M. F., Nature, 143, 1020 (1939).

[2] Melville, H. W., *Trans. Farad. Soc.*, 32, 1525 (1936).

[3] Schulman, J., and Rideal, E. K., Nature, 144, 100 (1939).

[4] Mottram, J. C., and Doniach, I., *Lancet*, 1156 (1938).

[5] Lowry, T. M., and Allsopp, C. B., *Proc. Roy. Soc.*, A, 133, 48 (1931)

Some Properties of Laccase from the Latex of Lacquer Trees

WE have previously shown[1] that laccase, the oxidizing enzyme present in the latex of the Indo-Chinese lacquer tree (*Rhus succedanea*), is a copper-protein compound. Our purest preparation of this enzyme, which catalyses the oxidation of polyphenols and diamines, contained 0·154 per cent copper and 6·45 per cent nitrogen, corresponding to about 45 per cent protein. The remaining fraction of the preparation was composed of a polysaccharide. This preparation had a strong blue colour which disappeared reversibly on the addition of reducing substances or substrates and irreversibly on heating the enzyme to about 60° C. or acidifying it.

It was, however, impossible to ascertain whether this deep blue colour was due to a special combination between the copper and the enzyme protein or to a colouring substance present in our preparations.

In order to determine the relationship between the colour and the enzyme we have made an attempt to obtain and study this enzyme from other sources such as the latexes of the Japanese and Burmese lacquer trees (*Rhus vernicifera* and *Melanorrhœa usitata*). As a result of this study we are now able to state that the laccases obtained from all three sources are copper-protein compounds and that the blue colour of all these enzyme preparations is not due to the copper but to the presence in these preparations of a blue pigment, the nature of which is under investigation. Although we have been unable to obtain an active enzyme preparation free from the blue pigment, the latter can be easily obtained completely free of copper and protein but always mixed with carbohydrates. The pigment preparation separated from the enzyme can be reversibly reduced to its leuco compound and irreversibly decolorized by strong acids and by boiling. The facts that the blue pigment of an active enzyme preparation is much more sensitive to acids and to heating than the free pigment, and that a colourless enzyme preparation could not be obtained, suggest the possibility that the pigment is in some way connected with the normal activity of the enzyme. It is, however, impossible to say without further study of the problem whether the pigment is intimately bound to the enzyme molecule as an additional prosthetic group or is bound to a carbohydrate and acts as a carrier between the enzyme and certain substrates. The purest laccase preparation we have so far obtained contains 0·24 per cent copper and is still of a deep blue colour.

Although laccase shows a very wide range of activity, extending to a great variety of *ortho-* and *para-*phenols, diamines and aminophenols, it does not catalyse the oxidation of monophenols such as *p*-cresol. This peculiar property of laccase preparations suggested at first that these preparations are devoid of an additional factor essential for this reaction and present in crude extracts of mushrooms or potatoes. It was, however, a matter of some surprise to us to find that the addition of such crude extracts to laccase preparation not only fails to reactivate it in relation to *p*-cresol, but also that the crude extract itself in presence of laccase loses its ability to catalyse the oxidation of this monophenol.

This peculiar inhibitory property of laccase preparations can only be ascribed to laccase itself and not to some additional factor present in the preparation. In fact, this property is not affected by dialysis, it is absent in blue pigment preparations devoid of laccase and it disappears from laccase preparation on boiling or after any other treatment which destroys the enzyme.

D. KEILIN.
T. MANN.

Molteno Institute,
University of Cambridge.
Feb. 2.

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[1] Keilin, D., and Mann, T., NATURE, 143, 23 (1939).

Inactivation of Prolactin by Treatment with Phenyl *Iso*cyanate

PHENYL ureido derivatives of serum albumin peptone[1], plastein[2], and native proteins[3], have been prepared by treatment with phenyl *iso*cyanate. This reaction is eminently suitable for masking the free amino groups of protein molecules without doing further damage, since the reaction conditions are very mild (0° C. and *p*H 8). Hopkins and Wormall[3] concluded that phenyl *iso*cyanate reacts only with the free amino groups of the lysine components of the protein molecules.

In view of reports that prolactin, the anterior pituitary hormone which stimulates the pigeon crop-gland, can be inactivated by acetylation with ketene[4], and treatment with nitrous acid[5], we were led to compare the crop-stimulating activity of prolactin with that of its phenyl ureido derivative.

Phenyl ureido prolactin was prepared by treating a solution of purified prolactin from ox pituitary with phenyl *iso*cyanate at *p*H 8 and 0°, diphenyl urea from excess phenyl *iso*cyanate being removed by centrifuging. The pigeon crop-gland stimulating activities of this and a control solution were estimated by Rowlands'[6] systemic method.

Test liquid	No. of birds	No. of daily injections	Volume injected (ml.)	Mean $\frac{\text{crop wt.} \times 100}{\text{body wt.}}$
Prolactin	9	6	1	1·12
Phenyl ureido prolactin	10	6	1	0·45

The results in the accompanying table show that destruction of the free amino groups by reaction with phenyl *iso*cyanate has resulted in a very marked loss of activity. The percentage inhibition (see Folley[7]) was approximately 87. The observations of Evans and his co-workers[4,5], that the crop-stimulating activity of prolactin depends on the presence in the molecule of free amino groups, appear therefore to be confirmed. These experiments are being continued.

A. C. BOTTOMLEY.
S. J. FOLLEY.

National Institute for Research in Dairying,
Shinfield, Reading.
Jan. 30.

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[1] Raper, H. S., *Hofm. Beitr.*, 9, 168 (1907).

[2] Folley, S. J., *Biochem. J.*, 26, 99 (1932).

[3] Hopkins, S. J., and Wormall, A., *Biochem. J.*, 27, 740 (1933).

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[5] Li, C. H., Lyons, W. R., Simpson, M. E., and Evans, H. M., *Science*, 90, 376 (1939).

[6] Rowlands, I. W., *Quart. J. Pharm. and Pharmacol.*, 10, 216 (1937).

[7] Folley, S. J., *Endocrinology*, 24, 814 (1939).

Hyperprothrombinæmia During Pregnancy

THE determination of prothrombin in blood plasma acquired especial importance after the discovery[1] of vitamin K, which is known to play a certain part in the formation of prothrombin. During my researches on the normal and pathological variations of prothrombin I have found the concentration of prothrombin in pregnant women to be remarkably high, a condition not formerly known.

The determination of prothrombin in plasma has been carried out according to a method recently indicated by me[2]. My method differs from those of others in that the prothrombin is determined in relation to a standard prothrombin solution. It has proved justifiable to take the blood plasma of the investigator as a standard solution. By means of this method the prothrombin values of 104 normal persons of both sexes have been determined. If the average value is put at 100, the distribution has been found to range from 82 to 118 with a standard deviation of 6·58.

The results of the determinations of prothrombin in pregnant women are seen in the accompanying table. The figures indicate the average prothrombin value in the women examined.

Month of pregnancy	Number of subjects	Average prothrombin value
1–2	7	105
2–3	8	111
3–4	7	123
4–5	5	136
5–6	4	149
6–7	7	146
7–8	5	152
8–9	27	169

It is apparent from this table that the average prothrombin values of all pregnant women examined after the third month of pregnancy are considerably higher than the average value of the normal material and exceed the highest values observed in the latter. The figures indicate a steady rise from the third month until the end of pregnancy.

One month after delivery, normal prothrombin values are found.

The significance of hyperprothrombinæmia in pregnant women will be further elaborated in a forthcoming publication.

O. THORDARSON.

Biochemical Institute,
University,
Copenhagen.
Jan. 24.

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[1] Dam, H., *Biochem. J.*, 29, No. 6, 1273 (1935).

[2] Thordarson, O., *Nordisk Medicin*, No. 3 (1940).

Interferometric Serum Test for Cancer

A PRACTICAL optical test of the blood serum that appears to prove of assistance in the early diagnosis and prognosis of cancer is here described, the validity of which has been ascertained in a few hundred clinical cases.

The test involves the measurement of the densities of a certain number of samples of the person's blood serum, by the use of an interferometer. The density to be determined is the result of interaction between an extract of cancer cells and the serum under examination.

Previous studies leading up to the test were those of Dr. Ernest Freund and G. Kaminer[1], F. Neuberg and A. Waterman[2], further refined by Drs. R. Willheim and K. Stern[3]. The first four investigators claimed to have established the following facts: A lysis of cancer cells takes place in the blood serum of non-cancerous persons. Serum of cancerous persons has not only no lytic substance but even a substance which protects cancer cells from destruction.

Willheim and Stern, however, stated that a diagnosis of carcinoma could not be made merely by determining the presence or absence of any specific cancer-destroying substance. They postulated the existence of cancer-destroying and cancer-protecting chemical principles in the serum, the difference in the balance of which determined whether or not a serum could be clinically associated with carcinoma.

It seemed that a surer and simpler diagnostic reaction should be obtained by using an extract of human cancer cells instead of the whole cells. An alcoholic extract of carcinoma of the breast, because of its convenience of freedom from infection, was prepared to serve as the testing agent. Four test tubes are set up. Into each of these is pipetted the same amount of cancer extract, 0·05 c.c. Next, the serum to be tested is added in each tube in increasing amounts, 0·05, 0·25, 0·5 and 1·0 c.c. respectively. Thus four grades of dilution of the extract with the serum are established. The tubes are then incubated at 37° C. for 12 hours. Serum is then added to the first three tubes until the level is the same as for the fourth test tube. All tubes are carefully shaken and allowed to settle in a refrigerator for six hours.

Interferometer readings are made to obtain the densities of the four dilutions of the extract with the serum. The pattern of the readings plotted out graphically shows a characteristic difference between the cancerous and non-cancerous sera.

Compared with the pattern of the four interferometric readings of normal serum, that of the cancerous serum shows a 'disturbed balance' between the cancer-lytic and cancer-protective properties.

A cancer curve slowly changes to a normal curve after successful operation. It changes again from a normal to a cancer curve in the earliest stages of recurrence. A cancer curve does not change post-operatively if metastases have already taken place or are about to take place elsewhere in the body.

The test reaction failed to appear when serum of a pregnant woman or of a person with tuberculosis, syphilis or numerous other diseases was used. However, as was to be expected, fever and intensive X-ray treatments influenced the serum so as to make the test uncertain. Extract of normal organs, for example, fibroid tissue, failed to show any reaction.

This preliminary report deals with 325 cancer cases in which the test was proved to be 96 per cent correct. Altogether 575 cases have been tested.

M. W. METTENLEITER.

St. Clare's Hospital,
Tumor Division,
New York City, N.Y.
Dec. 25.

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[1] Freund and Kaminer, *Wiener Klin. Woch.*, 34, 378 (1910).

[2] Waterman, A., *Biochem. Z.*, 188, 65 (1927).

[3] Willheim and Stern, *Biochem. Z.*, 239, 473 (1931).

A Vacuum Core-Sampler for Deep-Sea Sediments

FEW geophysical problems have such important bearings as that of sampling undisturbed sediment cores of great length from ocean deeps. Questions pertaining to the permanence of ocean basins or their subsidence, to continental drift, to climatic changes and to variations in volcanic activity, etc., can best be answered through studies of the stratigraphy of deep-sea sediments, sampled in the manner just indicated. Recently, Dr. Piggot of the Carnegie Institution of Washington has obtained cores from the north-west Atlantic bottom approaching 3 m. in length, by projecting the sampler into the sediment by means of an explosive charge.

According to a scheme advanced by one of us at the meeting of the International Council in 1933, the hydrostatic pressure prevailing at great depths has been utilized for forcing a tube-sampler down into the sediment. The first instrument, constructed during last summer in the workshop of this Institute and put to practical tests in the fall of the same year, consisted of a 2 m. length of steel tubing, 2 in. wide, closed at its upper end and having a water-tight piston at its lower end, released by trigger action as soon as it touched the sediment surface. The air was pumped out of the tube before immersion, so that the piston, followed by a column of sediment, was able to move up to the upper end without compressing any air behind it, which might otherwise expand and push out the core on hauling up the sampler to the surface. The tests made with this first sampler proved the release to function well, and the tube was filled with sediment; but at depths exceeding 150 m. the shock due to the impact from the piston proved too severe for the steel bolts securing the lid to the upper end of the tube. Moreover, the looser kinds of sediments were sucked into the tube, before it had time to descend completely into the sediment.

A modified instrument was accordingly constructed with a cylindrical container of much wider bore attached to the upper end of the tube. The container is evacuated, whereas the tube itself is completely filled with water which, after the release, is free to enter the container through a nozzle of a more or less narrow bore, according to the depth in which the sample is to be taken. Thus the rate at which the tube sinks into the sediment can be made practically equal to the rate at which the sediment core mounts into the tube. Tests with this new sampler made at depths down to 240 m. have been entirely successful, cores of lengths varying between 160 cm. and 200 cm. being readily obtained. Markings on the outside of the tube proved the sampler to have sunk into the sediment to a depth agreeing to within a few centimetres with the length of the core. A deep-sea sampler with a larger spherical container and a tube 6 metres in length is now being constructed and gives hope of obtaining cores of approximately the same length from depths of 4,000 m. or more.

With all types of samplers hitherto used, including that of Dr. Piggot, the friction against the inside of the tube prevents cores of equal length to the depth of immersion in the sediment being sampled (see Pratje's recent experiences in the Baltic). With the vacuum sampler this friction is counteracted by suction, properly regulated, so that the core will give a true picture of the undisturbed stratification of the sediment. Moreover, since the force pressing the tube down into the sediment increases with the bore of the tube, and with the depth of water, it should be possible to obtain cores of still greater thickness and length, say 10 m. if not even more, by means of this sampler. The instrument will be described in greater detail in a coming issue of *Meddelanden från Oceanografiska Institutet i Göteborg*.

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The α, β Transformation of Quartz

Sir C. V. Raman and T. M. K. Nedungadi have discussed in NATURE of January 27 a remarkable series of photographs showing the spectrum of monochromatic light scattered in a quartz crystal at various temperatures up to 530° C., not far from the transition point at 575° C. Their results are of special interest to me because they serve to confirm my opinion that, at any transition temperature (including the melting point), some kind of resonance occurs between two frequencies which characterize the two phases concerned. In other words, the transition takes place when there is close agreement between a frequency characteristic of the first phase and another frequency characteristic of the second phase. Since resonance may occur when this agreement is not quite exact, an explanation is possible of the fact that for many substances the 'setting' point is not quite the same as the 'fusion' point.

In the experiments on quartz, the authors state that "the 220 cm.$^{-1}$ line behaves in an exceptional way, spreading out greatly towards the exciting line and becoming a weak diffuse band as the transition temperature is approached. On the other hand, the other intense lines [including 132 and 468 cm.$^{-1}$] having both larger and smaller frequency shifts continue to be easily visible, though appreciably broadened and displaced". They infer that the binding forces corresponding to the line 220 cm.$^{-1}$ diminish rapidly with rising temperature, and also that the increasing excitation of this particular mode of vibration and the resulting deformation of the atomic arrangement are in a special measure responsible for the changes in the physical properties of the crystal, as well as for inducing the transformation from the α to the β form.

So far as I am aware, there is no information available as to the characteristic frequency of β-quartz save that which is obtainable from the Sutherland-Lindemann formula

$$\nu = \frac{3 \cdot 08 \times 10^{12}}{V^{1/3}} \sqrt{\frac{T}{M}},$$

where T is the absolute temperature of the melting point, M is the molecular weight, and V is the molecular volume. Assuming that T is 2,053° K., and the density is 2·65, the calculated frequency is $3 \cdot 63 \times 10^{12}$ sec.$^{-1}$, corresponding to 212 cm.$^{-1}$, and thus supports the hypothesis put forward.

For some time I have been examining the effect of substituting the absolute value of a transition point for T in the melting point formula, and have obtained interesting results. Taking 848° K. as the transformation temperature of α, β-quartz, the corresponding frequency is $4 \cdot 09 \times 10^{12}$ sec.$^{-1}$ or 136 cm.$^{-1}$. This is very nearly the same as the Raman line 132 cm.$^{-1}$.

The two suggestions which I wish to emphasize are these: (1) the occurrence of a transformation is associated with some kind of resonance between approximately equal frequencies characteristic of the phases concerned; (2) the applicability of the Sutherland-Lindemann melting point formula to the transition point.

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Chemical Action of γ-Radiation from ^{80}Br

DURING the course of an investigation into the exchange of radiobromine between a number of organic and inorganic bromides, it has been observed that with certain of the latter, for example, aluminium bromide, and a wide variety of organic bromides, a complete exchange of all the bromine atoms in the system takes place very quickly at room temperature. With many other inorganic bromides, however, there is apparently no exchange, but an *extraction* of the 18-min. ^{80}Br isotope from the radioactive organic bromide.

For example, if inactive antimony tribromide be dissolved in radioactive ethyl bromide several hours after the preparation of the latter, that is, when all the 18-min. isotope originally present has decayed, and immediately after the dissolution the ethyl bromide be volatilized away *in vacuo*, the residue of antimony tribromide is found to be strongly radioactive, with a half life of 18 min., the 4·5- and 36-hour periods being found in the condensed ethyl bromide.

That is, the antimony tribromide has made a selective extraction of the short-lived radiobromine isomer which has grown from, and is in transient equilibrium with, the parent 4·5-hour ^{80}Br. This result is to be attributed to a form of intramolecular photo-dissociation of the ethyl bromide by the internal conversion of the γ-ray which, as Snell[1], Abelson[2] and others have shown, is emitted by the bromine nucleus during the isomeric transition. A similar extraction was observed with arsenic tribromide, phosphorus pentabromide and, though the amount extracted was less, with crystals of mercuric bromide and of potassium bromide, and with metallic silver, mercury and even gold. In each case the radiobromine extracted was almost pure 18-min. ^{80}Br, the 'tail' to the decay curve due to the longer-lived isotopes being very small—generally less than 1 per cent of the total initial activity.

Segré, Halford and Seaborg[3] obtained a partial separation of the radiobromine isotopes by the precipitation of silver bromide from an aqueous methyl alcoholic solution of radioactive *tert*-butyl bromide, and DeVault and Libby[4] obtained a more complete separation by the precipitation of silver bromide from a radioactive bromate solution. These authors attributed the separation to a chemical activation of the molecule containing the bromine, by the recoil from an internal conversion electron. LeRoux, Lu and Sugden[5] have also found that a greater proportion of the 18-min. isomer than of the 4·5-hour isomer can be extracted by aniline from neutron irradiated ethylene dibromide, or by water from a benzene solution of a radioactive alkyl bromide, and offer as explanation[6] that the soft γ-ray gives a recoil which can only activate, but not disrupt, the C–Br bond.

The present results indicate, however, at all events in the case of ethyl bromide, that the process is not simply a matter of supplying an extra activation energy (over that received spontaneously by thermal agitation) to an otherwise exothermic reaction, since the removal of a bromine atom or ion from an ethyl bromide molecule by arsenic tribromide or mercuric bromide, for example, is endothermic by a very large amount.

Moreover, the mechanical recoil of the bromine nucleus from the γ-ray or from a conversion electron cannot be a major factor in these reactions. Siday[7] has shown that the energy of this γ-ray emitted during the transition is about 43,000 e.v. The energy of recoil of the comparatively heavy bromine nucleus from such a γ-ray is about 286 cal./mol., which is less than the energy of thermal agitation of the molecule at room temperature. The internal conversion of this γ-ray results in the expulsion of conversion electrons, the recoil from which will be greater than from the γ-ray, but even with 100 per cent efficiency of recoil would be less than 7 kcal./mol. Such an additional energy would accelerate the hydrolysis of an alkyl bromide, but could not bring about the present results. These suggest that a bromine atom or ion is broken completely away from the ethyl bromide molecule before reaction, a process requiring about 60 kcal./mol. if the disruption is into neutral fragments, and rather more for disruption into ions (much of the additional energy required to form the ions is recovered as solvation energy when the process takes place in solution).

It appears more probable, therefore, that the C–Br bond is broken immediately following the nuclear transition, not by mechanical recoil of the bromine atom, but by a process involving any one of a series of excited molecular states which are produced during the gradual settling down of the bromine atom after the start of the internal conversion. That is, the molecule is broken up, not merely activated, by a process which is more in the nature of a photo-dissociation brought about by intramolecular quanta.

All these reactions were carried out with anhydrous materials at room temperature, the ethyl bromide being volatilized away *in vacuo* ($\sim 10^{-3}$ mm. mercury), at or below room temperature and condensed by liquid air. The radiobromine was converted into AgBr, the activity of which was measured with a Lauritsen type quartz fibre electroscope.

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Feb. 2.

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[2] Abelson, *Phys. Rev.*, **56**, 753 (1939).

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[4] DeVault and Libby, *Phys. Rev.*, **55**, 322 (1939).

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Effect of Temperature on Lubricant Films

THE friction apparatus developed by Bowden and Leben[1,2] has shown that when clean steel surfaces slide on one another, the motion is not smooth but proceeds in a series of irregular jerks. This apparatus has also been used for comparing the lubricating properties of various substances. With the high loads and low speeds employed, the conditions which obtain correspond to boundary lubrication. Experiments show that when a non-polar lubricant such as medicinal paraffin oil is used, the motion still proceeds in stick-slips, though the average value of the friction is lower than for the dry surfaces. Certain long-chain fatty acids and small quantities of these acids in a non-polar oil will, however, cause continuous sliding[1,3]. This property has been used to detect the oxidation of non-polar oils on heating. The original oil gives a jerky motion; when a certain amount of oxidation has occurred the motion becomes smooth. The rate of this oxidation becomes appreciable with most oils at temperatures above 150° C. and the change in the frictional behaviour is irreversible on subsequent cooling[3].

Some recent work on commercial oils giving smooth sliding on steel surfaces at room temperature has revealed a new effect. As the surface is warmed (to temperatures usually ranging between 40° C. and 80° C.) stick-slips set in, which increase in size with temperature and decrease as the temperature is reduced. Provided the heating has not been sufficient to cause appreciable oxidation of the lubricant, this effect is reversible. Subsidiary experiments have shown that it is not due to any change of viscosity with temperature, and the effect is to be attributed to a desorption or disorientation of the lubricant film. These results indicate that *in those cases where boundary lubrication occurs*, a lubricant which behaves well at room temperature (that is, which gives smooth sliding) may have poor lubricating properties at quite moderate temperatures of the running parts. The temperature at which this reversible effect occurs will be a measure of the strength with which the lubricant film adheres to the surface; the higher the temperature the more strongly is the film adsorbed on the surface. It is possible by such means to compare different lubricants in this respect.

Experiments have also been carried out with pure fatty acids, and similar effects have been observed, though the temperature at which stick-slips commence is appreciably higher than the values given above and increases slightly with the chain length of the acid.

These observations are of importance in any general consideration of the effect of temperature on the behaviour of adsorbed films.

I am indebted to the Asiatic Petroleum Company for permission to publish this work, which was carried out in their laboratories.

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Points from Foregoing Letters

C. B. Allsopp has found that photo-oxidation products of 3 : 4-benzpyrene, which can be extracted with water or dilute alkali, possess characteristic absorption spectra. The unstable extracted material, which was shown by Schulman and Rideal to react strongly with protein monolayers, is found to produce a high percentage of abnormal mitotic cells in embryonic chick heart tissue cultures.

After examining the oxidizing enzymes, named laccases, obtained from the latex of the Indo-Chinese, Japanese and Burmese lacquer trees, D. Keilin and T. Mann conclude that they are all copper-protein compounds containing a blue pigment the nature of which is under investigation.

A. C. Bottomley and S. J. Folley find that the pigeon crop stimulating activity of the anterior pituitary hormone prolactin disappears when the free amino groups react with phenyl *iso*cyanate.

O. Thordarson finds that the prothrombin content of the blood plasma of pregnant women is higher than normal. A steady rise occurs from the third month of pregnancy until delivery; normal values are found again one month after delivery.

It is claimed by M. W. Mettenleiter that the density of blood serum incubated with an alcoholic extract of carcinoma of the breast, can be used as a test for cancer. When the observations are plotted, a characteristic difference between cancerous and non-cancerous sera is observed; this difference disappears after successful treatment and reappears with recurrence. The test fails in cases of pregnancy and of certain diseases.

The experimental results of Raman and Nedungadi on the α, β transformation of quartz are reviewed by Prof. H. S. Allen. Two suggestions are put forward: (1) at any transition temperature (including the melting point) some kind of resonance occurs between two approximately equal frequencies characteristic of the phases concerned; (2) the Sutherland-Lindemann melting point formula may be applied to the transition point.

Experiments on the exchange of radiobromine between organic and inorganic bromides are described by F. Fairbrother. The radiobromine with a half-life of 18 min. can be separated almost completely from the others by extraction of a radioactive organic bromide with certain inorganic bromides and metals. Since the energy of mechanical recoil, from the γ-ray emitted during the isomeric transition of ^{80}Br, or from its conversion electrons, is too small to break the C–Br bond or to bring about the observed reactions, these are attributed to a fission of the bond by an intramolecular photo-dissociation.

Using the stick-slip friction apparatus developed by Bowden and Leben, D. Tabor finds that certain lubricants giving smooth sliding on steel at room temperature give stick-slip motion when heated to moderate temperatures. This effect is reversible with temperature and has been observed with pure fatty acids. It is attributed to a desorption or disorientation of the lubricant film.

RESEARCH ITEMS

Facial Deformity in Anthropomorphic Pottery

It is pointed out by R. N. Salaman that in any considerable collection of Chimu Peruvian pottery there will be found among the anthropomorphic pots examples in which some peculiar deformity of mouth or nose or both occur (*J. Roy. Anthrop. Inst.*, 69, 1 ; 1939). Several different explanations have been put forward. Distinct groups may be recognized, namely, those which depict abnormal localized obesity, those in which the face is distorted as a result of facial paralysis, and those in which the mutilation is induced and associated with some representation, however conventionalized, of the potato. The potato was regarded as controlled by a spirit which was strengthened by blood libations effected by the act of mutilation. This mutilation consisted in the abscission of the upper lip, and often the lower as well and the removal of the soft parts of the nose. The effect was a startling display of teeth and a cavernous mouth, the explanation being that the Peruvians regarded a potato eye as a mouth, which indeed it resembles in the Peruvian varieties more closely than an eye. A pot of the proto-Chimu period from Chimbote shows the symbolism complete. It depicts a human figure built up from a single potato tuber, in which the end of the nose and the central portion of the upper lip are removed, while on the body are displayed potato eyes from each of which are growing several slender sprouts. In the left hand the figure holds a digging stick. A large number of the pots for funerary purposes exhibit facial deformities which might be illustrative of some disease process, such as, it is suggested, the *uta* disease due to an infection with the protozoan *Leishmania brasiliensis* in various stages, after surgical treatment and after death. The reason or reasons underlying the frequent representation by the ancient Peruvians of maimed and mutilated figures remain obscure.

Moulting in Snakes

A short paper by Robert M. Stabler, reporting upon twenty-one snakes observed for periods ranging from 11 to 47 months, adds to the somewhat meagre knowledge about this habit (*Copeia*, 227 ; 1939). The snakes belonged to seven different genera and fourteen species, and yet they showed similarity in the frequency of sloughing when account was taken of the periods of reduced activity, and when observations were confined to individuals which fed readily and were perfectly healthy. Continuous observations showed apparent dissimilarity ; thus in 47 months one specimen of *Agkistrodon piscivorus* sloughed fifteen times, while another sloughed three times in 12 months, and one individual of *Elaphe o. obsoleta* only twice in 12 months, the average periods between sloughs in these cases being respectively, 3·1, 4, and 6 months. But all the snakes were kept in a room not specially heated, and it was found that when winter temperatures fell as low as 40° F. a state of pseudo-hibernation or 'rest period' was induced, during which the snakes lay motionless for days, took food sparingly, and sloughed rarely. This period, extending from about October to April, averaged 6·4 months in the year. When the rest periods, which were carefully recorded, were omitted from the computation, the sloughing in the three cases mentioned took place respectively at intervals of 1·3, 2·3, and 1·2 months. In all the snakes the periods were somewhat similar, generally ranging around about 1·5 months.

Translocation in the Somatic Tissue

L. V. Morgan reports the finding of two salivary gland nuclei with a reciprocal translocation between the right arms of chromosome 2 and of chromosome 3 of *Drosophila melanogaster* (*Genetics*, 24, 747–752 ; 1940). The interchange must have occurred in the last or in a very late division in the nucleus of a somatic cell before the full number of cells of the salivary gland was attained. The discovery is of importance in showing that reciprocal translocations, like mutation, or crossing-over, may occur during mitosis as well as during meiosis.

Genetical Investigation in Neurospora

Neurospora tetrasperma normally has four spores per ascus, and differs in this respect from *Neurospora sitophylla*, which forms eight spores per ascus. One culture of *N. tetrasperma* was found by B. O. Dodge (*J. Hered.*, 30, 467–474 ; 1939) to form ascocarps which contained aborting and sterile asci. About 10 per cent of the ascocarps occasionally contained a fertile ascus, with usually eight not four ascospores. If these eight spores were cultured, those that germinate again produced 4-spored asci. On the other hand, a binuclear spore sometimes found in an ascus would give aborting ascocarps with an occasional 8-spored ascus, as in the original culture. It would seem that this culture of *N. tetrasperma* produced eight spores, half of which carry *E*, a lethal which prevents germination. As a result of segregation at the second division for both sex factors, *Aa* and the lethal *Ee*, a large spore may contain *AE* and *ae* in the two nuclei, and can germinate and give rise to ascocarps. Many of these will abort, but some will contain 8-spored asci, since *E* affects the nuclear distribution and spindle mechanism at spore formation.

Separation of Amino-Acids in Protein Digests

An interesting new method of protein analysis is outlined by R. L. M. Synge (*Biochem. J.*, 33, 1913, 1918, 1924 and 1931 ; 1939). The amino-acids in a digest are acetylated and then extracted with chloroform in a continuous liquid extractor. The partition coefficients of these acetylated amino-acids between chloroform and water vary so widely that separation into groups is readily accomplished, for example, acetyl-l-phenylalanine is soluble and *N* acetyl-l-hydroxyproline almost insoluble in chloroform. Subsequent benzoylation of hydroxy groups, however, produces derivatives easily soluble in chloroform such as *N*-acetyl-*O*-benzoyl-l-hydroxyproline and hydroxyamino-acids can thus be readily separated from other amino-acids. Fractionation of hydroxyamino-acids from each other may be carried out by preparing their *N*-acetyl-*O*-methyl derivatives, which have very different chloroform-water partition coefficients.

Solvent Effect on Solubility

THE solubilities of barium iodate, silver acetate and silver sulphate in dioxane-water mixtures at 25° over the complete range of solvent mixtures have been determined by T. W. Davis, J. E. Ricci and C. G. Sauter (*J. Amer. Chem. Soc.*, 61, 3274; 1939). This corresponds with a variation of dielectric constant of 2·10 to 78·55 (the widest so far reported in solubility work), and the results have been treated in the light of the interionic attraction theory and Born's theory of solvent interaction, in which the free energy of charging spheres of radius r in a medium of dielectric constant D is set equal to $Z^2e^2/2Dr$, where Z is the ionic valency and e the charge on the electron. This equation, even when corrected for interionic effects, fails to account for the variation of solubility with solvent, the predicted solubility in each case being too low. An empirical result, that the mean activity coefficient of an electrolyte in saturated solution is almost independent of the dielectric constant of the medium, is pointed out. The test of the Born equation applied was to determine whether the value of a, the effective ionic diameter, remained constant from one medium to another and was related to the solubility and dielectric constant according to an equation made up by combining Born's equation with the Debye-Hückel equation containing the simple correction for ionic diameter. This was not found to be the case. The questions of a changing with solvent and incomplete ionization of solute (for example, with barium iodate) are to some extent considered by the authors, but not the use of a more accurate equation for activity coefficients than the Debye-Hückel equation.

Chaulmoogra Oils

CHAULMOOGRA is the native name of the oil expressed from the seeds of the fruit of the *Taraktogenos kurzii*, and it has been used for centuries in Burma and India in the treatment of leprosy. The tree is widely distributed in Burma and is also found in Thailand (Siam), eastern Bengal and Assam. The gathering of the seeds is dangerous on account of wild animals, and as the fruit is no longer fresh when gathered the oil is of poor quality and is often adulterated. The name 'chaulmoogra' is also applied to any oil containing chaulmoogric acid, such as *Hydnocarpus wightiana* and *H. anthelmintica*. The latter occurs abundantly in Thailand, Cambodia, Cochin China and Laos, and has been successfully cultivated in Hawaii and the Belgian Congo; its seeds form an article of export to China, where they are known as Ta-fung-chi or Ta-feng-tzu. *T. kurzii* has also been acclimatized to Brazil. H. I. Cole and H. T. Cardoso (*J. Amer. Chem. Soc.*, 61, 3442; 1939) find that chaulmoogra oil (from *T. kurzii*) keeps for years if expressed from dried fresh seeds and not from old seeds, and is non-irritating upon injection. They give the first quantitative analyses of oils from *H. anthelmintica* and *T. kurzii*, finding that they contain hydnocarpic, chaulmoogric, gorlic, oleic and palmitic acids as well as small amounts of lower homologues of hydnocarpic acid. They also give the physical and analytical characteristics of five chaulmoogra oils. One of these (from *O. echinata*) contained no hydnocarpic acid but was very rich in chaulmoogric acid. The true chaulmoogra oil contained the highest percentage of gorlic acid.

Prehistoric Copper

AT a meeting of the Newcomen Society held at the Iron and Steel Institute on February 14, Mr. H. H. Coghlan read a paper on "Prehistoric Copper and Some Experiments in Smelting". Native copper, he said, occurs as thin plates, or in massive form in crevices in the rocks. The latter form is very intractable to work, and it was the former that prehistoric man used for making such things as needles, awls, beads and chisels. These were made by cold-working. As to the discovery of the processes of tempering, melting and smelting, Mr. Coghlan thought that at some early date, say about 5000 B.C., small objects were made by hammering; then when tempering was discovered and understood, larger objects were made, followed by, first, the discovery of smelting, and then of melting. The discovery of the process of smelting from ore must have been accidental. Some thought it was due to ore melting in a camp fire. To test this theory, the author made experiments trying to reproduce the conditions likely to have obtained, but the result was negative. Taking the green carbonate malachite, he had subjected it to the heat of a charcoal fire, but all he obtained was black oxide of copper. The result led him to try smelting the ore in an arrangement in which the conditions were such as existed in the ancient pottery kiln, and in this experiment he obtained metallic copper in the form of well-shaped crystals. Mr. Coghlan concluded by discussing the problem of how malachite may have been used in connexion with pottery.

Constants of the Star-Streams

W. M. Smart and T. R. Tannahill have utilized the photographic proper motions of 18,323 stars in the zone −40° to −52° for the determination of the constants of the star-streams (*Mon. Not. Roy. Astro. Soc.*, 100, 1; November 1939). The results of the analysis according to the two-stream theory are as follows:

	Drift i	Drift ii
R.A. of apex	88·0° ± 1·4°	303·6° ± 9·5°
Dec. of apex	−8·5 ± 0·6	−75·0 ± 13·5
Space velocities of drifts	1·463 ± 0·035	0·650 ± 0·035

The probable errors are small in the case of Drift i but they are not very satisfactory in the case of Drift ii. The vertex of the star-streaming is R.A. 271·5° ± 1·6°, Dec. −14·5° ± 2·0°, or, in galactic co-ordinates, long. 343·2° ± 1·0°, lat. −0·5° ± 1·7°. The vertex derived from the Cape proper motions is seen to lie on the galactic equatorial plane, but the longitude exceeds that derived by other methods by 16°, though it is almost exactly the same as Jackson's value. The equatorial co-ordinates of the solar apex are R.A. 265·1°, Dec. +26·1°; solar speed 0·879 astronomical unit. From the values of the stream-constants the ellipsoidal constants are calculated, and the results are compared with those obtained by Jackson from his analysis of the proper motions according to the ellipsoidal hypothesis. Those obtained by the first method are $G_0 = 334·6° \pm 1·2°$, $K/H = 0·705 \pm 0·002$, and the corresponding values found by Jackson are 343·6° and 0·59°; G_0 denotes the longitude of the vertex and K/H is the ratio of the minor axis to the major axis of the velocity ellipsoid. The authors show that a very close agreement between the two values derived by such dissimilar methods is not to be expected.

GLUTAMIC ACID OF PROTEINS

THE recent claim of Kögl and Erxleben[1] that the proteins of malignant tissues are partially racemized was based largely on the observation that the hydrolysates of such proteins, unlike those derived from normal tissues, contained glutamic acid which showed evidence of racemization, in some cases to a high degree. In our preliminary communication[2] we directed attention to the fact that we had been able to isolate the normal, unracemized, l (+) glutamic acid hydrochloride in good yield from three different samples of malignant tissue protein material, and suggested that a more extensive investigation was needed before Kögl and Erxleben's claim could be admitted. In reply, these latter workers[3], *inter alia*, produced evidence which they believed to show that our modified Foreman[4] method of analysis was unsuitable for demonstrating the presence of any racemized glutamic acid in protein hydrolysates, because the calcium salt of this acid is more soluble in 90 per cent alcohol than is that of the natural l (+) antipode, and also because the racemic hydrochloride is more soluble in either concentrated or 20 per cent hydrochloric acid than is that of the natural product.

Our own investigations have now led us to conclusions that are still at variance with those of Kögl and Erxleben, and a paper giving full details of our work has been submitted for publication in the *Biochemical Journal*. The points to which we wish to direct attention in this communication are as follow:

(1) The calcium salts of both the racemic and the l (+) glutamic acids are equally insoluble in 90 per cent alcohol, and the fact that our modified Foreman method of analysis is applicable to hydrolysates containing large amounts of the racemic acid follows from the data for the wheat protein gliadin given in the accompanying table.

Protein material	Method of analysis	Glutamic acid isolated		Yield of d(−) glutamic acid as per cent of protein
		Yield as per cent of protein	Percentage racemization	
Normal ox heart	Foreman	11·93	2·7	0·16
Normal calf lung	Foreman	8·70	1·8	0·08
Grafted sarcomata from mice	Foreman	8·34	2·7	0·11
Metastases from liver of a woman with carcinoma of colon (E.B.)	Foreman	10·28	4	0·22
Metastases from liver of a man with carcinoma of bronchus (W.V.)	Foreman	10·25	2·8	0·165
,,	Cuprous oxide: First crop	0·44	63·4	0·14
	Second crop	2·39	1	—
Gliadin	Direct as hydrochloride,	33·53	nil	—
	followed by Foreman analysis	9·55	46	2·21

(2) When the method is applied to hydrolysates containing only a small amount of the racemized acid, the first two or three crops of hydrochloride isolated will consist almost exclusively of the l (+) antipode, and it is necessary to search the mother liquors to obtain evidence for the racemized product. What we believe to be well-nigh quantitative glutamic acid analyses of three malignant tumour and of two normal tissue protein preparations are given in the table. In all five cases the yield of total glutamic acid is high, but that of the unnatural d (−) antipode is very low, and there is no apparent differentiation between the two types of tissues. It is clear from these results that our failure to demonstrate the presence of the racemized acid in our earlier tumour analyses was due to the fact that the natural l (+) antipode was present in large excess.

(3) The above-mentioned results are not in keeping with those of Kögl and Erxleben. The latter workers, using the Dakin butyl alcohol procedure, have in two instances isolated products showing a high degree (80 per cent; 89 per cent) of racemization in yields that indicate 4·16 per cent and 3·69 per cent respectively of the d (−) antipode in terms of protein material taken for analysis. Nevertheless, in the majority of their analyses they have used the shorter, cuprous oxide, method of Abderhalden and Fuchs[5], and whereas from normal tissue materials the products isolated in yields of from 1·65 per cent to 5·0 per cent showed the normal rotation, those obtained from malignant tumour materials, in yields sometimes as low as 0·34 per cent, always showed a high degree of racemization (20–85 per cent). Because they had shown that the hydrochloride of the racemic acid was more soluble in concentrated hydrochloric acid than that of the natural antipode, they have assumed that the glutamic acid they failed to isolate from the hydrolysate would be racemized to at least the same degree, and have accordingly interpreted their results as showing the presence of the d (−) antipode in amounts comparable with those obtained from the two samples of malignant tissue mentioned above.

That this is not a valid interpretation follows from the results given in the table, which show that under the conditions of these cuprous oxide analyses the racemic glutamic acid hydrochloride may be preferentially salted out, even when the l (+) glutamic acid is present in very large excess. In the case quoted, the first crop by the cuprous oxide procedure, obtained in only 0·44 per cent yield, showed 63·4 per cent racemization, yet the companion Foreman analysis, which gave an overall yield of 10·25 per cent, showed only 2·8 per cent racemization.

These findings explain the apparently conflicting results recorded in the recent literature[6] and show that the interpretation of Kögl and Erxleben's cuprous oxide analyses must be based on the *yield* of the product isolated and not on its *percentage racemization*. A review of their data on this basis suggests that, except in three cases, the amount of d (−) glutamic acid present in the various malignant tumour hydrolysates was of the same order (0·5 per cent) as we ourselves have obtained from both malignant and normal tissue material, and much less than we have obtained from seed proteins, such as gliadin and edestin. We have, moreover, isolated partially racemized aspartic acid from the hydrolysates of both types of animal tissue protein, and are thus led to conclude that racemization of amino acids is not a characteristic of malignancy.

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[1] Kögl and Erxleben, *Z. physiol. Chem.*, **258**, 57 (1939).

[2] Chibnall, Rees, Tristram, Williams and Boyland, NATURE, **144**, 71 (1939).

[3] Kögl and Erxleben, *Z. physiol. Chem.*, **261**, 154 (1939); Kögl and Erxleben, NATURE, **144**, 111 (1939); Kögl, Erxleben and Akkerman, *Z. physiol. Chem.*, **261**, 141 (1939).

[4] Foreman, *Biochem. J.*, **8**, 463 (1914).

[5] Abderhalden and Fuchs, *Z. physiol. Chem.*, **57**, 339 (1908).

[6] Arnow and Opsahl, *Science*, **90**, 257 (1939); Graff, *J. Biol. Chem.*, **130**, 13 (1939); White and White, *J. Biol. Chem.*, **130**, 435 (1939).

IN 1939, Kögl and Erxleben[1] reported the isolation from tumour proteins of amino-acids of the *d*-series, chiefly *d*-glutamic acid, and developed a new theory of the origin of malignant tumours based on the view that malignant growth depends upon the alteration of the proteins in tumour cells owing to the inclusion of racemized amino-acids. Chibnall *et al.*[2] failed to detect the unnatural form of glutamic acid in hydrolysates from tumour proteins. Graff[3] was also unable to reproduce Kögl's results. According to Kögl[4], the failure of these authors to obtain *d*-glutamic acid was due to the fact that they used a different method for its isolation. White and White[5] and Arnow[6] confirmed the results of Kögl in a small number of experiments, but Dittmar[7], who followed Kögl's technique for the isolation of glutamic acid, failed to detect the *d*-form of this acid in proteins from the growing parts of different types of sarcoma, though he was able to establish racemization of glutamic acid in the proteins from necrotic malignant tissue.

GLUTAMIC ACID FROM NORMAL AND MALIGNANT TISSUES.

Source of tissue	$[\alpha]_D$	Amino-nitrogen (per cent)	Weight of hydrolysed material (gm.)	Amount of isolated glutamic acid (mgm.)	Notes
Normal rabbit's muscle	+ 31·50°	7·51	—	—	
,, ,, blood	+ 31·0	7·31	—	—	
Muscle from rabbit affected with Brown-Pearce carcinoma	+ 31·0	7·3	—	—	
Blood from rabbit affected with Brown-Pearce carcinoma	+ 31·3	7·76	—	—	
Brown-Pearce carcinoma	+ 26·5	7·67	67	180	No visible necrosis
,, ,, ,,	+ 31·0	7·8	63	215	,, ,, ,,
,, ,, ,,	+ 31·5	7·31	60	185	,, ,, ,,
,, ,, ,,	+ 31·0	7·4	62	335	Slight necrosis
Rous chicken sarcoma	+ 27·0	7·31	28	90	No visible necrosis
Krichevsky-Sinelnikow rat sarcoma	+ 31·5	7·34	40	150	,, ,, ,,
Methylcholanthrene sarcoma (rat)	+ 22·0	7·53	20	130	,, ,, ,,
,, ,, ,,	+ 31·5	7·45	26	98	,, ,, ,,
Liver of rats painted with *o*-amino-azotoluene	+ 31·5	7·6	—	—	

I have isolated glutamic acid from normal and malignant tissues by the method described by Kögl, due notice being taken of the technical details stated in his second paper. The experimental results are summarized in the accompanying table. As seen from these data, partial racemization of glutamic acid has been observed in a few cases in malignant tumours. In the majority of the tumours, however, no 'unnatural' glutamic acid was present. The extent of the possible loss of the *d*-form in the course of the isolation procedure was ascertained in an experiment in which 100 mgm. racemic glutamic acid were added to the hydrolysate from 5 gm. of dry muscle proteins. From this material 670 mgm. glutamic acid were obtained, with an amino nitrogen content of 7·51 per cent and 27·5° specific rotation. Thus 42·8 mgm. have been recovered from the 50 mgm. of *d*-glutamic acid added to the muscle protein hydrolysate. Further, we have recrystallized from 20 per cent hydrochloric acid 200 mgm. of a glutamic acid mixture with $[\alpha]_D = +24°$ made from 150 mgm. *d*-acid and 50 mgm. of the racemate. Upon recrystallization we obtained 174 mgm. glutamic acid with $[\alpha]_D = +25°$. These values show that the percentage of *d*-form lost in the course of isolation and purification of glutamic acid from protein hydrolysates by Kögl's method is low.

Our experimental data justify the conclusion that the presence of *d*(−) glutamic acid in tumour proteins is not a regular phenomenon attending malignant growth. Our present aim is to investigate the causes of the presence of *d*-glutamic acid in the hydrolysates from certain tumours. The data at our disposal for the present give no reason to associate this phenomenon with bacterial activity in the necrotized parts of the tumours, as suggested by Dittmar.

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[2] Chibnall, A. C., Rees, M. W., Tristram, G. R., Williams, E. F., and Boyland, E., NATURE, **144**, 71 (1939).

[3] Graff, *J. Biol. Chem.*, **130**, 13 (1939).

[4] Kögl, F., Erxleben, H., and Akkermann, A., *Z. physiol. Chem.*, **261**, 141 (1939).

[5] White, I., and White, M., *J. Biol. Chem.*, **130**, 435 (1939).

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RELEVANT to the discussion which has taken place recently between Chibnall[1] and Kögl and Erxleben[2,3] are some facts which I have accumulated in an analysis of gliadin. Kögl and Erxleben find that the glutamic acid derived from the proteins of malignant tissue is partially racemized and suggest that this might be a characteristic of such proteins. Chibnall found tumour proteins to contain the bulk of their glutamic acid in the ordinary active form with $[\alpha]_D + 31 \cdot 6°$ in 9 per cent hydrochloric acid, and he thought that any racemization was incidental to the methods employed in its isolation. The work described here indicates that a vegetable protein such as gliadin also contains part of its glutamic acid in a racemic form, and that it is probably a general characteristic of proteins and not of special significance for the proteins of tumours.

600 gm. air dry protein (91·6 gm. nitrogen) were hydrolysed for thirty-six hours with 30 per cent sulphuric acid, the acid removed with baryta, and the barium salts of the dicarboxylates precipitated by adding 3 vols. of 95 per cent alcohol. This precipitate was dissolved in dilute hydrochloric acid, freed from barium, and saturated with hydrochloric acid gas. Five crops of glutamic acid hydrochloride were precipitated, with characteristics as shown in the accompanying table.

It was thought that this might be the derivative obtained from *d*-*l*-glutamic acid and so a sample of *l*(+)-glutamic acid was racemized by boiling a 0·4 *M*. solution in normal caustic soda for 130 hours until the specific rotation was zero. The free amino-acid was isolated, but still yielded the 3 : 5 dinitrobenzoyl derivative m.p. 104°.

It is thus not 3 : 5 dinitrobenzoyl *d*-*l*-glutamic acid.

The free acid is only sparingly soluble in hot water, and its equivalent weight by titration against standard baryta is 144. The copper salt is easily soluble in water and it sets to a glass on evaporation. Its rate of ring closure at *p*H 4 to form pyrrolidone-carboxylic acid is almost identical with that of known glutamic acid. On oxidation with free hypochlorous acid it yields succinic acid. All these factors confirm the belief that it is a glutamic acid.

Samples of the 3 : 5 dinitrobenzoyl compounds, m.p.'s 104° and 203°, were next hydrolysed by heating in a sealed tube at 120° for eight hours. The specific rotations determined in micro-polarimeter tubes indicated that the 104° derivative yielded an amino-acid having $[\alpha]_D$ in 9 per cent hydrochloric acid + 13·5°; whereas the 203° derivative gave an amino-acid with $[\alpha]_D - 2°$. As the rotation observed was only $-0 \cdot 14°$ in a somewhat cloudy solution, it might well be that the solution was inactive.

Total Nitrogen Precipitated as Dicarboxylates 24·6 gm.

Crop	Wt.	m.p.	Wt. as free glut. acid	% N	% Cl	Rotation 4% aq. soln.	Gm. N in fraction	m.p. of 3 : 5 dinitrobenzoyl. deriv.	Yield of deriv.
1	225·0 gm.	207°	181·0 gm.	7·55	19·40	+ 25·0°	17·0	104°	40·0%
2	15·0 gm.	203°	12·1 gm.	7·40	19·48	+ 20·8°	1·0	104°	40·0%
3	7·5 gm.	203°	6·0 gm.	7·43	19·5	+ 19·1°	0·55	104°	39·4%
4	7·0 gm.	202°	5·6 gm.	7·40	19·4	+ 24·0°	0·53	104°	38·1%
5	3·0 gm.	175°	2·4 gm.	7·45	19·3	+ 5·8°	0·23	203°	{51·6%
	Isolated in su	bsequent	fractions				19·31 gm.	104°	3·0%
			6·0 gm.				0·59 gm.N.	203°	58·0%

All five fractions were converted to 3 : 5 dinitrobenzoyl derivatives with the results indicated—the first four fractions yielding a derivative having m.p. 104°; the last crop a 203° m.p. derivative. Both derivatives analyse as for 3 : 5 dinitrobenzoyl glutamic acid, but the 104° derivative crystallizes with one molecule of water, whereas the 203° derivative is anhydrous.

The mother liquors from the precipitation of glutamic acid hydrochloride (4·4 gm. nitrogen) were reprecipitated with baryta and alcohol, giving a precipitate (2·34 gm. nitrogen) and a filtrate (2·02 gm. nitrogen of which 0·55 gm. nitrogen was present as NH_3). The precipitate was freed from barium, converted to copper salt to separate aspartic acid and then subjected to Dakin's treatment in order to see if any hydroxyglutamic acid was present. None was found, but the silver precipitate and the silver filtrate together yielded another 6 gm. of a glutamic acid which gave a 3 : 5 dinitrobenzoyl derivative, m.p. 203° (≡ 0·57 gm. nitrogen).

The copper aspartate which looked a homogeneous blue crystalline mass was also examined, and from it by crystallization there was obtained 2·35 gm. of glutamic acid and 2·25 gm. aspartic acid. It would thus appear as if the copper salt were a double salt of copper aspartate and copper glutamate (1 : 1), as the 4·86 gm. of amino-acid obtained from it would require to be in the ratio 2·55 gm. glutamic acid : 2·31 gm. aspartic acid. This glutamic acid also yielded a 3 : 5 dinitrobenzoyl derivative m.p. 203°.

There is thus the curious fact that the first four fractions of glutamic hydrochloride yield a 3 : 5 dinitrobenzoyl derivative which crystallizes with 1 H_2O and has m.p. 104°. Fraction 5, however, yields a derivative, crystallizing without water, m.p. 203°, and all the subsequent fractions yield the 203° m.p. derivative.

The amino-acids obtained by hydrolysis of the 3 : 5 dinitrobenzoyl compounds were re-benzoylated, and this time both yielded the derivative m.p. 203°.

It appears to me that the probable explanation of these facts is that the glutamic acid obtained by hydrolysis of the protein contains, besides *l*(+)-glutamic acid, some racemic glutamic acid; and as *d*-*l*-glutamic acid yields the derivative m.p. 104°, this racemic acid is probably not an artefact but a definite hydrolysis product. It is important to remember that this *d*-*l*-glutamic acid received violent treatment (boiling for 130 hours with normal sodium hydroxide) in comparison with that accorded to the natural glutamic acid. However, to complete the investigation a study of the equilibrium conditions for the reaction

$$d\text{-}l \text{ (mixt.)} \rightleftharpoons \text{racemic (compd.)}$$

is being undertaken both for glutamic acid itself and for its 3 : 5 dinitrobenzoyl derivatives.

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[1] Nature, **144**, 71 (1939).

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[3] Nature, **144**, 111 (1939).

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL REPORT

THE Association of Special Libraries and Information Bureaux arranged to hold its sixteenth annual conference at University College, Nottingham, during September 15–18, 1939. Owing to the War, the meeting did not take place, but a report including the papers which were to have been presented together with the Council's report on the year's work of A.S.L.I.B. 1938–39 and a report of the fourteenth annual general meeting held on November 24, 1939, has now been issued*. The report indicates that the membership stands at 334 as against 325 in the previous year, and the financial position continues to restrict the activities of the Association. One hundred and eight translators are now registered, but this service is not nearly so widely used as it should be. At the annual meeting, the chairman emphasized that under war conditions the need for a clearing house for information is accentuated and the Council aims at keeping the work of the Association going as normally as possible.

Of particular interest to scientific workers are the papers dealing with "Thesis Literature" by Colonel Luxmoore Newcombe, of the National Central Library, Mr. Watson Davis and M. Julian Cain. Colonel Newcombe, dealing with the accessibility of British university thesis literature, emphasizes the need for more information about such theses, to which we have no adequate guide. The accessibility of theses for consultation or loan is discussed and some details are given of existing catalogues in university libraries and the collections of foreign theses in such libraries. Colonel Newcombe also discusses the feasibility of compiling and publishing a national guide to these theses, as well as the advisability of each university filing in its library two copies of each unpublished thesis accepted for any degree. The compilation of such a catalogue of unpublished theses in each university library, and the collection in one library, possibly the National Central Library, of copies of published foreign theses, which would be available for loan, also require consideration.

Mr. Watson Davis, in his paper dealing with the accessibility of the thesis literature of the United States, emphasizes the service which the American Documentation Institute is able to offer for obtaining American dissertations on microfilm in co-operation with the libraries and institutions concerned. M. Julian Cain's notes on thesis literature in France describe the centralization of such theses in the Library of the University of Paris (Sorbonne). A complete set is sent to each university library in France annually and to all foreign libraries participating in the exchange scheme.

A paper by G. S. Fulcher discusses the value of author's abstracts as an aid to documentation and advocates the extension of this system, preferably through some organization such as the International Federation of Documentation. Dr. L. A. Sayce contributes a paper on microphotography in 1939 in which he refers to the research work proceeding at King's College, Newcastle-on-Tyne, and the need for a central library, preferably in London, to take the lead in Britain by establishing a well-equipped micro-copying bureau.

Papers of more general interest are those in which Sir Harry Lindsay describes the work of the Imperial Institute as an information centre ; Mr. Guy Pocock describes the libraries and information bureau of the British Broadcasting Corporation, and Mr. Thomas Baird discusses the cinema and the information services, in which he emphasizes the important educational work the cinema could render in wartime conditions, notably in evacuation problems.

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* Report of the Proceedings of the Sixteenth Conference, organized to be held at Nottingham University College, September 15th to 18th, 1939. Pp. 92. (London: A.S.L.I.B., 1939.) 5s.

LEVEL MEASUREMENT AND CONTROL

AN important class of instruments among those required for scientific purposes as well as for the many accurate measurements which are now an essential feature in industrial and engineering undertakings is that which is designed for indicating, recording and controlling liquid levels. Many devices have been adopted for these purposes, one being the employment of compressed air which is arranged to be slowly discharged through an open tube the end of which is submerged in the liquid. As the head of liquid above the open end varies, so does the pressure of air, thus giving an indication of the level. Instruments of this type are suitable for almost any fluid and give single or multi-point readings, or they may be adapted for continuous records. Where the provision or use of an air supply presents difficulty or is undesirable for special reasons, depth indicators and level recorders may be of the self-contained pressure bulb type. The bulb is installed at the zero of the level to be measured and is connected by tubing to the instrument, which may be at any desired height above or below the liquid and at any reasonable distance from it.

For tanks the mercury column can be conveniently employed, and a precision type of instrument based on this principle is capable of an overall accuracy of 0·005 of an inch of mercury. Instruments for level and depth alarm or control are of pneumatic or electrical types and, at maximum or minimum or both, they operate bells, klaxon horns or pilot lights to give warning or regulate a diaphragm control valve so as to maintain any desired level. The pneumatic principle can be applied also to measure the specific gravity of liquids of variable density by two standpipes connected to a differential pressure indicator or recorder. In a list recently issued, Messrs. Negretti and Zambra, who have wide experience in the manufacture of instruments of these types among many others, have supplemented the illustrations with accessory schedules and diagrams showing how the several models are employed and connected under different conditions of service. More than a catalogue, it is thus a handbook for the reference of those responsible for the selection and installation of level measuring instruments.

THE PUBLIC HEALTH IN WAR-TIME*

IN every war of which we have records the wastage from disease has outnumbered many times the losses from killed and wounded. Figures from the War of 1914–18 support this statement, as well as the experience of the Walcheren expedition and the Crimean campaign.

Military and civil authorities are both interested in the maintenance of the public health in war-time. Military and civilian health authorities successfully co-operated in this respect during the War of 1914–18, and similar arrangements have been made in the present war.

While indirect war consequences, such as alterations in diet, excess of work and worry and the pandemic of influenza (1918–19), contributed to increased rates of mortality among civilians in the War of 1914–18, the record of civil public health was good on the whole. The population increased and the infant mortality rate was lowered. It must be remembered that that War saw the beginnings of those personal health services which have done so much to improve the health of the community; for example, the School Medical Service (1907), the Insurance Medical Service (1912), the Tuberculosis, Maternity and Child Welfare and Venereal Disease Services. It is a harder task in the present War to maintain the health services at the high level they have reached. In addition, unprecedented demands have been made on the national health services. The central health authority has become a more important arm of defence, and has had to organize an emergency medical service, in itself a stupendous task, and an evacuation scheme for school children, expectant mothers young children and other priority classes of the population.

An account of the emergency medical service and of the medical problems of the evacuation scheme was also given.

Certain criticisms of the evacuation scheme were discussed. It was emphasized that the Public Health and School Medical Services should not be blamed for departures from the normal standards of cleanliness and conduct found in certain of the evacuees. The root cause of these conditions lies in the home. They mean that slum clearance has not yet gone far enough, that low standards of living still persist, and that the lessons taught in the school and clinic sometimes fail to reach the older generation.

It was suggested that the policy of preparing for casualties and of evacuation may have played no inconsiderable part in the present freedom of Great Britain from enemy air raids.

Reference was made to certain diseases—deficiency diseases, tuberculosis, venereal diseases, influenza, infectious diseases, cerebrospinal fever—which are the objects of special concern in this War. The civilian arm has yet to receive its baptism of fire. If that stern ordeal comes, it will endeavour to keep the flag of national health flying in the storm of war as zealously as it did in the sunshine of peace.

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* Substance of a Chadwick Public Lecture delivered on February 20 by Sir Arthur MacNalty, K.C.B., Chief Medical Officer of the Ministry of Health.

HAULAGE PRECAUTIONS IN MINES

OF the deaths caused by haulage accidents in mines, the fact that over a period of eight years nearly 25 per cent were due to runaway tubs is sufficiently serious to indicate this as a subject demanding inquiry. One of the lines of research undertaken in this connexion was to determine the relative degree of effectiveness of the different types of backstay which are used as one means of arresting potential runaways. The backstay, which is known by several local names, is a strong steel bar which trails along the rail track at the rear of the string of tubs, its function being to dig into the track if the train tends to run back. Frequently its action is ineffective, and this led to one line of research being directed by the Department of Mines towards ascertaining the chief causes of the failures and the ways and means of preventing them by improving the design of this simple safeguard. The results of this investigation have now been published under the title "Backstays for use in Mines" (Safety in Mines Research Board Paper No. 103. H.M. Stationery Office. 1*s*. net). which describes all the steps taken and results obtained and makes available to the coal mining industry the conclusions reached.

Representative types of backstays having been obtained from several coalfields, these were examined for variations in design. They were classified in four groups, the classification mainly depending on the method of attachment to the tub. In other respects very marked differences were noted; length varied from 23 to 42 inches and weight from 9¾ to 72 lb. They were subjected to a number of tests under conditions simulating those which might actually occur when tubs are on an incline, such as allowing tubs to run back for some feet before the stay is free to operate, or being bumped into by a runaway. The results of the several tests are recorded in relation to the four different groups of the original classification. From these it was possible to draw conclusions as to a suitable mode of attachment, safe limits of length, weight and cross-section and general construction. It is interesting to note that the ideal length is about that of the longest stay examined and its weight should be about 40 lb.

The metallurgical and mechanical tests of the materials used in the sample stays showed that they have usually been made of soft steel and therefore have been relatively weak and easily bent. The report recommends that high quality steel should be used, preferably 1·5 per cent manganese steel as previously suggested for colliery haulage drawgear.

In addition to the details of the investigation, the paper gives the analysis of the problem in relation to different numbers of tubs on various inclines. The formulæ published should be of considerable assistance in checking the sizes required under any given conditions.

TRANSVERSE DISTRIBUTION OF HORMONES IN PLANTS

BY E. D. BRAIN

"THE relation between various types of hormone distribution is the internal regulating mechanism of a plant." This conception underlies the theory of the transverse reactions of plants which Georg Borgström discusses in a recent publication[1]. He emphasizes the physiological importance of transverse hormone distribution in relation to polar transport. Starting from the discovery that treatment with ethylene upset the normal transport of auxins and caused a transverse flow out of the phloem into the surrounding tissue with consequent swelling of the cells, Borgström studied various natural conditions which produced similar effects. He found that light of short wave-lengths, high humidity, high and low temperature, action of specific chemical substances, mechanical stimulation of the phloem and the age of the plant organ were factors which influenced the direction of auxin distribution, by diverting the normal polar stream into transverse channels with resulting reaction in the plant. Among these "transverse reactions" of the plant he classes tropistic growth responses, the light-growth reaction, secondary growth, root formation, root contraction, water transport, fruit development and leaf fall. He also discusses various other physiological and morphological problems in the light of his theory and suggests that the transverse distribution of hormones is responsible for various ecological types; the strength of the reaction being governed by the extent to which normal growth is upset by the transverse effect.

It is impossible to discuss here the numerous applications of the transverse theory, but I propose to deal with Borgström's interpretation of the mechanisms of photo- and geo-tropism, which is in some way illustrated by my own work on geotropism[2]. According to Borgström, light induces lateral hormone transport which increases the transverse growth of cells of the cortex and retards their elongation on the light side of the stem. Histological studies by various workers have endorsed this, and Borgström's measurements for cells of the cortex in Pisum stems and Lupinus and Helianthus hypocotyls, when submitted to unilateral illumination, show marked increase in width and decrease in length on the illuminated side. A transverse growth effect is therefore included in the mechanism of phototropic curvature. What has been termed as increased sensitivity in the dark can also be explained as the normal elongation proceeding without interference from transverse light effects. A study of geotropically curved stems shows increased width of cells on the lower side, accompanied by elongation due to the accumulated auxin from the transverse effect of gravity. In the root the same distribution takes place but, since auxin inhibits growth, the lower side is retarded and positive curvature results. In my investigations on the growth of plants for prolonged periods on a klinostat, I have found histological changes which indicate the resultant of processes which would normally produce curvature. In hypocotyls of *Lupinus albus*, marked increase in the radial walls of the cortical cells was noted, and in radicles, cells of the cortex were much shorter in longitudinal section but only slightly smaller in transverse section. It appears as if radial extension is the predominant factor in negative curvature of the stem, whereas in roots the inhibition is more in the longitudinal direction. Reaction of shoots and roots is different and it seems doubtful if the transverse effect can be so complete an explanation of positive geotropism as Borgström suggests.

Besides seedlings, flowers and leaves of *Narcissus pseudo-narcissus* and fronds of *Asplenium bulbiferum* were grown on the klinostat. In Narcissus flowers no bend in the receptacle occurs on the klinostat but, at the stage when the bud bends normally, changes occur in the outer layer of cells. The difference in length of the dorsal and ventral halves of curved flower stalks has been explained by Zollikofer[3] as being due to the unequal elastic pressure of the two halves, as a result of unequal growth hormone distribution. On the klinostat the normally unequal distribution would be equalized and alteration in the elastic pressure might result, causing the tangential stretching of cells which are compressed when bending occurs normally. It is significant that these changes coincide with a maximum development of statoliths in the receptacle, which points to the possibility of some link between the statolith apparatus and the bending mechanism.

In Narcissus leaves the epidermal cells are shorter and there is a greater number of stomates on both the inner and outer surfaces of the leaves grown on the klinostat. The cells of the cortex of *Asplenium bulbiferum* fronds are much wider radially and shorter on the klinostat than in upright plants. On the klinostat there is less sclerenchyma formed. The walls of the sclerenchymatous cells are much thinner and the cells are half as long and more than twice as wide as in upright fronds. Heyn[4] has shown that geotropic stimulus causes changes in the plasticity of cell walls as a result of auxin redistribution. In this case the continual transverse auxin supply prevents the cells ageing and losing their plasticity, and the formation of sclerenchyma is retarded. In all cases examined, no difference was found in the distribution of starch and statoliths in plants on the klinostat. Borgström questions the idea of the statolith mechanism and geotropic reaction being causally related. He considers that it is the transverse distribution of auxin caused by gravity which increases the mobility of the starch grains and facilitates their falling, at the same time inducing differential growth of longitudinal and transverse cell walls. From experiments with onion and oat roots he shows that auxin activates diastatic processes and accelerates the transformation of starch into sugar, and he assumes that it is a transverse distribution of auxin which causes the disappearance of starch from developing tissues, making sugar available for growth purposes. Should this be so, one would expect to find that an artificially induced transverse distribution would change the distribution of starch in klinostat plants.

It is clear that a change in the direction of auxin distribution may alter the plasticity of cell walls and lead to definite changes in plant tissues. The possible applications of this theory offer wide scope to the research worker in many problems of plant physiology and morphology.

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[2] Brain, E. D., *New Phytol.*, 38, 3 (1939).

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THE SCATTERING OF WAVES IN RADIO TRANSMISSION

FOR many years past, the mode of propagation of radio waves through the ionosphere has been studied intensively by mathematicians, physicists and radio communication engineers. It is now well known that all long-distance communication takes place by deflection of the waves in one or other of the ionized regions of the atmosphere, and furthermore that, depending upon the density of ionization of any particular region, there is a maximum frequency of the waves which will be deflected and above which the waves penetrate the region and are not returned to the earth. This critical penetration frequency increases with the angle of incidence of the waves on the ionosphere. Thus, while the general features of long-distance radio transmission can be interpreted in terms of a simple ray treatment of the waves passing from the earth up to the ionosphere and back to the earth, there is a minimum distance from the sending station at which signals can be received by this mode of propagation. This 'skip' zone or distance, as it is termed, is naturally subject to diurnal and seasonal variations, as well as to the actual frequency used in the transmission.

Although all normal commercial communication takes place by the transmission of waves to ranges beyond the skip zone, it has been known for some time that, inside this zone, signals may be received more or less spasmodically, these signals being very irregular and subject to large variations in both intensity and direction of arrival at the receiving station. This type of reception has been interpreted as being due to the scattering of waves from local irregular portions or clouds in the ionosphere, where the intensity of ionization is such as to give rise to a diffuse reflection of the waves in all directions.

In a paper read before the Wireless Section of the Institution of Electrical Engineers on February 7, Mr. T. L. Eckersley presented an analysis of the effect of scattering in radio transmission. The earliest experimental evidence of scattering was obtained from observations at Chelmsford in 1927, when the short-wave beam stations were first opened. In general, such scattered signals within the skip zone gave no definite bearing indication on a direction-finder unless the sending aerial emitted a directive beam, in which case the apparent direction of travel of the waves was approximately the opposite to that in which the beam of rays was projected. In later work, it has been possible to measure the time delay of the scattered signals in relation to the ground or direct ray, and also in some instances to the normal echoes received after one or two reflections from the *F* region of the ionosphere. The scattered echoes are of relatively low intensity and thus only become suitable for quantitative observation when a high-power transmitter is available, and the use of a pulse modulation makes possible the measurement of the time of arrival of the individual echoes.

Photographic records demonstrated by Mr. Eckersley showed that the scattered echoes have a moderately well-defined minimum time of arrival, but beyond this, the received echoes are spread over a considerable period in an irregular manner. A complete investigation of the phenomena showed that the cause of such scattering lies in momentary irregularities and small clouds in the *E* region of the ionosphere. Since the wave frequencies employed were generally much greater than the critical frequency of the *E* region, the path of transmission from the sender involved penetration of this region, reflection at the higher *F* region, followed by scattering from the upper side of the *E* region, and so by a second reflection from the *F* region back to the receiving station on the ground. The time delays of the echoes fits in with this explanation, and the fact that the average intensity of the scattered signals varies approximately as the fourth power of the wave-length is in accordance with the scattering coefficient of ionic clouds in the *E* region.

The effect of scattering is of major importance in the analysis of long-distance radio transmission phenomena, and the results of the investigation described in the paper referred to do much to increase our knowledge of the subject and our understanding of the mechanism by which the scattering is produced.

R. L. S-R.

SEVENTY YEARS AGO

Nature, vol. 1, February 24, 1870

The Minister of Public Instruction

Reference is made in a leading article to the Education Bill, the first reading of which was taken in the House of Commons "last week". The reception given to the Bill suggests that a Minister of Public Instruction will shortly be appointed.

"Such a Minister should, we think, take charge of the whole range of natural knowledge in all matters in which the State in any way intervenes to advance such knowledge. We understand the comprehensive term natural knowledge to include Education, Science, the Fine Arts, and Music. . . . The Education branch would include the national system of compulsory primary education about to be established, public schools, universities. . . . The Science branch would include all establishments, in receipt of Government assistance, in which Science is taught as a special study; all those in which scientific observations or investigations are conducted under State auspices, and all museums in which natural objects are displayed for scientific purposes. . . . The first step towards organizing this branch of knowledge must be by collecting facts and opinions relating to it. This step can only be taken through the agency of a Royal Commission instructed to give the widest possible scope to its inquiries into everything relating to both Instruction and Investigation in Science."

"A deputation consisting of Earl Fortescue, the Right Hon. C. B. Adderley, Dr. Farr and others, had an interview with Mr. Shaw-Lefevre at the Board of Trade on Saturday to recommend the legislation of metric weights and measures in the Post Office, and the legal substitution of metric weights for the troy weight which the Standard Commissioners propose to abolish."

"We have to record the decease of Mr. J. F. Sowerby, so well-known in connection with the illustration of botanical works, especially the new edition of the English Flora, edited by Mr. J. Boswell-Syme, now nearly completed."

"A method of protecting iron from atmospheric influences has been proposed by Messrs. Macmillan and Macgregor, of Dumbarton and Glasgow. They bring melted sulphur into contact with the cold metallic surface to be coated. The sulphur chills and sets into a hard, thin, protecting cover."

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Resident Headmistress of the Royal Masonic School for Girls, Rickmansworth Park—The Secretary, Royal Masonic Institution for Girls, 31 Great Queen Street, Kingsway, W.C.2 (March 1).

Chief Chemical Inspector, Chemical Inspection Department, Royal Arsenal, Woolwich—The Ministry of Supply (S.E.3.B.), The Adelphi, W.C.2 (quoting Appts. 021/S.E.3.B.) (March 4).

Lecturer in Bacteriology, Royal Veterinary College, and Research Assistant in the Research Institute in Animal Pathology—The Bursar, Royal Veterinary College, The University, Reading (March 9).

Headmistress of the County School for Girls, Gravesend—W. A. Clench, Bank Chambers, Windmill Street, Gravesend (March 11).

Professor of Mechanical Engineering—The Secretary, The University, Birmingham (April 20).

Part-time Teacher in Chemistry—The Head of the Department of Chemistry and Biology, The Polytechnic, Regent Street, W.1.

Civilian Wireless Instructors at the Electrical and Wireless Schools, Royal Air Force—The Under-Secretary of State (S.5.D.), Air Ministry, Adastral House, Kingsway, W.C.2.

Assistant Mechanical Engineers for the Electrical Branch, Public Works Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9067).

Mechanical and Electrical Engineer for the Public Works Department of the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9120).

Two Assistant Engineers—The Engineer, Nene Catchment Board, Priestgate, Peterborough.

Temporary Forecasters, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B.(Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

Headmaster of the Sydney Grammar School, Sydney, New South Wales—The Agent-General for New South Wales, 125 Strand, W.C.2, or The Secretary to the Trustees, Sydney Grammar School, Sydney.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Royal Commission on the Distribution of the Industrial Population. Report. (Cmd. 6153.) Pp. x+320. (London: H.M. Stationery Office.) 5*s*. net. [62

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (D. T. A. Townend) for the Session 1938–39. Pp. 18. (Leeds: The University.) [72

Mines Department. Eighteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1938, and the Thirty-first Annual Report of H.M. Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. xx+271. (London: H.M. Stationery Office.) 4*s*. net. [72

Father and the Family. Pp. 12. (London: National Baby Welfare Council.) 2*d*. [82

Mines Department. Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas. Pp. 27+2 plates. (London: H.M. Stationery Office.) 9*d*. net. [82

Tenth Annual Reports of the National Radium Trust and Radium Commission, 1938–1939. (Cmd. 6161.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net. [92

Smoke Abatement in Wartime. Pp. 12. (Epsom: National Smoke Abatement Society.) [92

Transactions of the Zoological Society of London. Vol. 24, Part 7: The Mammals of the North Cameroons Forest Area; being the Results of the Percy Sladen Expedition to the Mamfe Division of the British Cameroons. By Ivan T. Sanderson. Pp. 623–726+22 plates. (London: Longmans, Green and Co., Ltd.) 50*s*. [122

Other Countries

Smithsonian Miscellaneous Collections. Vol. 99, No. 1: Sketches by Paul Kane in the Indian Country, 1845–1848. By David I. Bushnell, Jr. (Publication 3553.) Pp. ii+25. (Washington, D.C.: Smithsonian Institution.) [12

Proceedings of the United States National Museum. Vol. 87, No. 3075: A Taxonomic Study of Neotropical Beetles of the Family Mordellidæ, with Descriptions of New Species. By Eugene Ray. Pp. 271–314. (Washington, D.C.: Government Printing Office.) [22

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries. 43, 1938: On the Migrations and the Racial Character of the Plaice. By Erik M. Poulsen. Pp. 80. (Copenhagen: C. A. Reitzel.) [62

New Zealand State Forest Service. Misc. Series No. 1: Forestry in New Zealand. Pp. 24. (Welington: Government Printer.) [62

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1938 to March 1939. Pp. 10. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s*. [62

Field Experiments on Sugar-Cane in Trinidad. Annual Report for 1939. By P. E. Turner. (Published by the Sugar-Cane Investigation Committee.) Pp. 262. (Trinidad: Government Printing Office.) [62

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 204: Flax in Egypt. Part 1: Research and Culture. By Dr. M. A. El Kilany. Pp. 4+32+10 plates. P.T. 3. Bulletin No. 215: Jute and Kindred Fibres in Egypt—Research and Culture. By Dr. M. A. El Kilany. Pp. 6+22+12 plates. P.T. 3. (Cairo: Government Press.) [122

Publications of the South African Institute for Medical Research. No. 45: A Study of Experimental Tissue Reactions following Intravenous Injections of Silica and other Dusts. By F. W. Simson and Dr. A. Sutherland Strachan. Pp. 95–122+25 plates. (Johannesburg: South African Institute for Medical Research.) [122

Annals of the New York Academy of Sciences. Vol. 39, Art. 4: American Cities and States; Variation and Correlation in Institutions, Activities, and the Personal Qualities of the Residents. By Edward L. Thorndike. Pp. 213–298. (New York: New York Academy of Sciences.) [122

Field Museum of Natural History. Anthropological Series, Vol. 31, No. 1: Anthropometric Observations on the Eskimos and Indians of Labrador. By T. Dale Stewart. Material and Data collected by William Duncan Strong. (Publication 462.) Pp. 164+16 plates. (Chicago: Field Museum of Natural History.) 1.75 dollars. [122

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THE UNIVERSITIES IN WAR-TIME

THE function of the universities in relation to research needs in war-time may not be so well appreciated as other factors which at the present time are directing attention to their place in the national life of Great Britain. Like other educational institutions, their work has in many places been seriously disturbed by the exigencies of evacuation. Both research and teaching have been interrupted, and even where satisfactory and efficient arrangements have been made in the reception areas for the performance of those functions, great difficulties have frequently been met by students. These difficulties, for example, have deprived University College, London, and the London School of Economics of half their students. Although a number of evacuated university institutions are now expected to return to their normal quarters by the autumn term, there is sound reason in the appeal of the National Union of Students for a Government grant to enable students who would otherwise be deprived of their education to continue their studies.

The attempt to return to normal education and to evolve a sound and practical policy out of the muddle into which evacuation has thrown it must include university education along with the elementary and secondary stages. In contrast to 1914, the universities have indeed already been recognized by Government as institutions of national importance, both from the point of view of assisting in the War, and also of maintaining higher learning and culture. The welcome news that the Government has decided to maintain its Treasury grant at the pre-War level (see NATURE, February 24, p. 299), strengthens this conviction. In the contacts of the past year or so between the universities and the Service and other Government departments in regard to the utilization of personnel and facilities, and particularly in the sympathy and understanding which characterize this co-operation, we have evidence that the role of the universities in supplying the educated and trained leadership essential in handling the problems of a democratic society is fully appreciated by the Government.

If therefore it is admitted that universities are vital necessities in the efficient service of the needs of a democratic society, whether as an industrial nation in a world where science is the basis of power, or in the defence of its life, its liberties and traditions against the methods of modern warfare, it can scarcely be disputed that a grave responsibility must rest on the universities in the preservation of the permanent values of our ordinary life. The autonomy of government, the freedom of speech and thought and investigation which are cherished privileges of British universities, place upon them a prime responsibility to provide the informed and disciplined intelligence that alone can be adequate to meet the needs of a post-War world, to repair the breaches made in our institutions by the War, and to reconstruct those parts of our political and economic system which are shown to be defective by the War. If reconstruction is to have a practical meaning, it requires at once the trained and disciplined intelligence, the impartial and patient analysis, the imaginative insight on human issues, the sense of values and creative force which it should be a chief glory of our universities to supply.

The importance of the contribution which the universities can make to the winning of the War, to the planning of the peace and the provision of leadership of the requisite capacity, makes it essential that the ways and means by which that contribution is made should be rigorously re-examined. It is no simple problem to secure the economy that may justly be demanded, without endangering the deeper values which a university must always safeguard. The Treasury grants to the universities have always recognized the right of the universities to enjoy complete freedom. In war-time, that independence must be preserved at all costs. Nothing is easier than for the essential liberties for which we are contending to be endangered and lost by gradual encroachment under the duress of war.

Unsleeping vigilance in these matters is essential, but the universities must prove themselves worthy of that independence by the thoroughness of their response to the national need, and the ability with which they not only maintain their highest traditions but also raise the efficiency of their service. On the economic side there are things with which they can do without, and without which they will be content. They will not expect the same funds for new buildings which in better times they ought to have. It is not in war-time that we can expect most of our modern universities to approach nearer to the Platonic ideal that youth should be brought up "amid fair sights and sounds".

The essentials of university education must not be stinted. Municipal bodies, like the State, should continue their help at least undiminished, increasing it where those essentials are lackingor inadequately provided. Even in war-time, it is a good investment for the nation to provide at the modern universities more opportunities for healthy recreation as a part of the corporate life. The Physical Education Centre which the University of Manchester has recently opened is a token of the movement to make the life of the modern university more rounded and complete. Behind that movement, moreover, lies the possibility of developing a system of physical education which will make the student's life happier and more efficient in the best sense ; and there is a large field for research, the knowledge garnered from which may be applied not only to university students but also to adolescents generally.

Here is only one of the directions in which the universities might, even in war-time, extend their services to the community. There is also a great task in extra-mural work, which some of them are already shouldering, despite all the handicaps imposed by the black-out. Programmes of lectures are being provided for troops in the areas served by the universities in an attempt to see that the minds of those called to the colours do not stagnate or become set in Service grooves. In spite, too, of the dislocation of civil life and the long hours put in on munitions, the demand for tutorial classes is strong, and the teaching normally done outside the universities on their own initiative or in collaboration with the Workers' Educational Association proceeds vigorously.

The significance of this extra-mural work should not be under-rated. As Dr. W. C. Mitchell reminds us in his presidential address to the American Association for the Advancement of Science (see NATURE of February 10, p. 207) the gravest dangers to democracy come from within, not from without. The universities have a decisive part to play in dispelling ignorance and countering by critical inquiry the propaganda which turns ignorance to its uses. In war as in peace, those who cherish learning must seek to foster, by all means within their power, a scientific attitude among their fellow citizens. Extra-mural work offers an invaluable opportunity of developing respect for evidence and promoting a general understanding of the methods and results of science.

Important as may be the educational functions of the universities in such extra-mural fields, it is to the training given within their walls and to their functions in the advancement of knowledge and the maintenance of standards that attention is at present being most clearly directed. The pursuit of knowledge and the training of youth must indeed go hand in hand with the cherishing of human values—of personality, of freedom and truth—if a university is to make its full contribution to the enrichment of national life, above all by inspiring that deep consciousness and appreciation of the national heritage which alone can sustain the effort and sacrifices which their defence may well demand in the present struggle. Whatever resources may be available for the universities—and the importance of their contribution to our war effort and the preservation of the permanent values of our heritage may well justify expansion rather than contraction of those resources—the present position demands that they should be used as wisely and efficiently as possible.

It is from this point of view that it is imperative to re-examine the utilization of these resources and their distribution over the various functions of a university and the numerous branches of learning which it serves. Let no one imagine that this is a simple task. The complexity of the relations between the different functions and faculties must not deter us from the task, and the gravity of the danger which threatens all alike may well be sufficient at last to initiate the effort.

In regard to the advancement of learning, the university occupies a place in the research front. If knowledge is to be available to serve the war-time needs of the nation no less than to solve the problems of peace, some means must be found of keeping an appropriate balance between fundamental and applied research, of providing for the following-up of advances in knowledge, and of diverting effort to fields neglected or holding up the general advance. All this must be done without endangering that freedom of investigation and spirit of unprejudiced quest for truth which lie at the root of all scientific advance. Particularly is it important to provide for investigations in the domain of human relations, where lack of knowledge is already handicapping our war effort in many fields.

The advancement of knowledge links itself naturally with the teaching functions of the university through the thorny problem of the relation of teaching and research. Here we may well have to review the whole question of technique in the light of recent criticism and discussion on the use of the lecture or the tutorial system. Similarly, we have to consider the efficiency of research at the universities, not merely in terms of the claims of teaching, tutorial or administrative duties, but also in regard to the provision of adequate assistance or services in the laboratories, so that the best use is made of the time of qualified research workers.

These are questions which, like those of professional training, may well occupy the attention of the universities themselves and also of the many professional associations of scientific workers and their fellows. We cannot expect in the stress and strain of war to find and apply a completely satisfactory solution to them all. We may indeed need to be content with eliminating major causes of inefficiency and securing a modicum of co-operation in the pursuit of knowledge where it is most required. If, however, scientific and professional workers, whether within the walls of a university or without, are zealous enough in cherishing a high ideal of the functions of a university and give their minds, even in war-time, to such problems as these, then at least we may be sure that the universities of Great Britain will carry undimmed through these dark days their power to inspire, and to provide the loyal and unselfish leaders the nation needs both now and in the days of reconstruction to come.

CANCER: THE ROLE OF SURGERY, RADIUM AND X-RAYS IN ITS TREATMENT

THE treatment of cancer has occupied an increasingly important position in public thought during the last few years. The debate in Parliament on the Cancer Bill laid bare the scanty provisions for adequate treatment existing in many parts of Britain. The war crisis in September which temporarily curtailed medical facilities resulted in an insistent demand for the treatment of cancer, a demand not immediately heard for the treatment of most other diseases. One aspect of this interest is the difference of opinion as to the proper scope of radium treatment relative to other methods, a difference illustrated by recent and present correspondence in NATURE (**144**, 973; 1939; **145**, 151; 1940; also p. 347 of this issue).

Before attempting an assessment of the present status of cancer treatment, it will be instructive to examine first the extent to which cancer is in fact being treated in Great Britain at the present time, and the means available. A recent Ministry of Health inquiry* showed that in a representative sample 27 per cent of all cases were actually treated by either surgery or radiation, including purely palliative treatment. Allowing for possible groups of cases not coming into the sample, it is safe to say that less than 30 per cent of all cases occurring receive treatment. As to the means available, there are only two by which successful cure of cancer can be achieved—surgical excision and radium or X-ray therapy.

*"Cancer: An Enquiry into the Extent to which Patients receive Treatment." Reports on Public Health and Medical Subjects, No. 89 (H.M. Stationery Office.)

Surgery was first in the field, and indeed was for many years the only available method of treatment. The principle underlying its use is simplicity itself; extensive removal of the growth along with the whole of the affected part. The effective use of surgery in cancer dates back to about half a century ago. At that time surgical techniques were evolved which are still known by the names of their creators—Halstead, Kocher, Wertheim, and many more. The surgery of cancer is now relatively stable; its accomplishments are known, its limitations accepted.

In contrast to surgery, radium and X-ray therapy are still young and developing branches of medical science. Although radium was discovered in 1898 and was applied to minor medical use shortly afterwards, it did not become an important means of treating cancer until after the War of 1914–18. In the decade 1920–1930 the significance of the work which was being done in three now famous radiation therapy centres—the Fondation Curie in Paris, the Radiumhemmet in Stockholm, and the Memorial Hospital in New York—was gradually realized. It was not, however, until about the end of that decade that the impact of these revolutionary methods became generally felt. In Great Britain one result was the establishment of the Radium Trust and the creation of the National Radium Commission Centres for the provision of efficient radium treatment. It is then no overstatement to say that this new medical specialty is a mere ten years old, and still in an evolutionary phase. This fact has three consequences. In the first place, it is only over a very limited field of use that methods of treatment are as yet sufficiently standardized to represent an established practice of modern medicine. In the second place, it is vital that its value be judged in terms of its capacity as known to-day, and not in terms of its accomplishments of even a brief five years ago. Thirdly, it holds considerable promise for the future.

To arrive at an objective analysis of the relative value of surgery and radiation it is worth while first to examine the nature of the 27 per cent of treated cases mentioned above. The striking fact which emerges from such a study is that treatment is limited to a comparatively small number of cancer types. Of the 27 per cent of all cases occurring which in fact received treatment, no less than three-quarters belonged to one or other of the following five cancer groups: cancers of the stomach, intestine and rectum; cancer of the breast; cancer of the skin, including genitalia; cancers of the mouth, tongue and lip; cancers of the uterus and vagina.

Cancer of the stomach, intestine and rectum constitutes almost exactly 400 out of every 1,000 cancer deaths and represents one of the very commonest types of cancer found. In view of this, it is depressing to find that only 8 per cent of this group are seen sufficiently early to permit an attempt at cure. The treatment is almost exclusively surgical and radiation is as yet of little value. A generous estimate of the percentage cured would be 15 per cent of cases treated.

Cancer of the breast constitutes 200 cases per 1,000 of all cancer deaths occurring in women. It was found to have been treated in 68 per cent of cases. Breast cancer undoubtedly represents the field in which surgery has accomplished its greatest victories. It is still the treatment of choice except in those cases which are inoperable when first seen. In these, radiation does provide a useful alternative method. In many cases both surgery and X-ray therapy are combined with great advantage. A fair estimate of the surgical cure-rate is 25–30 per cent of all cases operated on. In the really early cases a cure rate of up to 75 per cent can be obtained. Cancer of the breast should be looked upon, therefore, as a mainly surgical field.

Carcinoma of the skin represents only a small proportion of all the cases occurring. It can be treated by wide surgical excision, or it can be treated by radiation—either radium or X-rays—with equal or even greater certainty of cure and without the same degree of disfigurement; indeed, often such a return to normal occurs that the site from which the disease was eradicated cannot be distinguished. An estimate of the cure-rate of true skin cancer (squamous cell carcinoma), adequately treated by either method, may be given as about 75 per cent. The less serious form of skin cancer, known as rodent ulcer, if treated properly rarely proves fatal. This field is therefore one which can be equally called surgical or radiological, but the cosmetic advantage lies with radiotherapy.

Cancer of the mouth constitutes just under 100 cases per 1,000 of all cases occurring in men, and analysis showed that 71 per cent were treated. There is little doubt now that radiation, particularly radium, has become the treatment of choice in this disease. The majority of mouth cancers occur in parts where surgery is not practicable. Where excision is possible, for example, in some carcinomas of the tongue, surgical cure is infrequent and is attended with marked disability. Extension of the disease from the mouth to the glands in the neck may, however, be dealt with either surgically or radiologically. Many cases of mouth cancer come for treatment when the disease is already advanced, yet even so cure-rates of 25–30 per cent for all the cases treated have been reported by British radiation therapy centres. For the early case, the chance of cure is at least 50 per cent. The mainstay of treatment of mouth cancer must therefore be accepted as being radium therapy.

Cancer of the uterus (uterine cervix) represents 133 cases per 1,000 deaths from cancer in women. Before the days of radiation it was treated surgically. This has now been abandoned in all modern schools. The present situation has been described in a recent survey where it is stated that "radiation offers a prognosis some 10 per cent better plus an appreciable salvage of inoperable cases. . . . To-day the prognosis from good radiation therapy is a one in two chance of cure in an operable case, and a one in seven chance in an inoperable case, and in selected centres the prognosis is even better, the chances being two in three and one in four respectively". The rapid transition from surgical to radiation treatment is largely due to the statistical findings of the Health Section of the League of Nations. This disease can therefore be listed as an exclusively radiation field.

These five diseases together account for 75 per cent of the treated cases. The remainder include cancers of the lung, œsophagus, bladder, ovary, larynx and a large variety of less common lesions. Talking in general terms, treatment by surgery and by radiation is probably about equally common, and radiation is showing curative possibilities in a number of lesions which are impossible of surgical approach.

We see, therefore, that in three out of the five main curable types of cancer considered, radiation now occupies a place so generally accepted that patients treated otherwise cannot be considered as receiving the maximum chance of cure.

The value of radium and X-ray therapy is, however, not limited to the treatment of forms of cancer in which permanent cure is possible. It can serve two other quite important functions. In a wide group of malignant growths, which include the lympho-sarcomata, radiation can control the disease and maintain the patient in a fair state of health for long periods. Another way in which radiation is extensively used is to obtain palliation of advanced cancers where cure is impossible. These cancers include the late stages of all those types which are curable in the early stages by radiation or surgery and many more. The growth of the tumour can be arrested temporarily, with disappearance of the attendant pain and disability. Even although life is only prolonged for a short time the reduction in suffering is great. Surgery has contributed two useful measures to the palliation of cancer—gastrostomy and colostomy. Both these measures, by affording mechanical relief in incurable cases, prolong life and reduce suffering.

Much has been written on the dangers of radiation treatment, as in the past of the dangers of surgical treatment. Where the disease concerned is cancer, in which the mortality of untreated cases is 100 per cent, danger should obviously not be overstressed. In surgical techniques a certain 'operative mortality' is regarded as inevitable. In the use of radiation for the cure of cancer similar 'treatment risk' must be faced. In both surgery and radiotherapy this risk varies in direct ratio to the magnitude of the undertaking and in inverse ratio to the skill of the operator or therapist. While the immediate risk of death is lower with radiation treatment, a new risk has to be taken, namely, that of local necrosis due to the treatment. At times this is unavoidable, and necroses may be faced at the time of treatment as being the price of what is regarded as curative treatment. Such necroses can be repaired later by plastic surgery.

The nature of the action of radiation on malignant tissue is a totally different process from that of excision, and radiation should not be thought of as a refined form of cautery. While surgery seeks the eradication of the disease by wide excision, radiation has a selective action on malignant cells in those groups of cases where the radiotherapist claims success. In the epitheliomata and the sensitive sarcomata it is possible to give a dose of radiation which will destroy the malignant cells while doing only temporary harm to the surrounding normal tissues. The margin between lethal dosage to the malignant cell and the lethal dose of the normal tissue is, however, quite a narrow one. To permit the successful use of this differential sensitivity an expert training in radiotherapy is necessary, both to assess a suitable dosage and to choose the best means of delivering that dosage accurately to the tumour with a minimal radiation of healthy tissue.

Radiation has occasionally been stated to produce metastases and to 'stimulate' the growth of malignant cells. Neither of these statements can be substantiated.

In the development of radiotherapy a vast amount of experimental work is still necessary. At present the techniques employed are based on clinical experience, which is necessarily conservative. The choice, for example, of radium versus X-rays depends on the mechanical applicability of either to any particular lesion rather than on any known advantage of wave-length. In accessible sites it is usual to choose radium, which remains the more valuable of the two methods. X-rays are used in the radiation of deep-seated lesions and in widening the zone of tissue treated from a radium source.

Another factor which requires investigation is the optimum overall time of radiation. At present the times used depend on clinical experience, and it is felt that other overall times or time splittings of dosage may be found in the experimental field which will alter considerably our methods of treatment.

While stressing the need for developmental work in radiation methods and the value of surgery and radiation in their respective fields, it is necessary to state that the greatest increase in the cure-rate in these fields would be obtained by a successful campaign to get patients in the early stage of their disease. A well-planned scheme of public education and clinics as envisaged in the Cancer Bill would facilitate this.

RUTHERFORD

Rutherford
Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M. By Dr. A. S. Eve. Pp. xvi+451+18 plates. (Cambridge: At the University Press, 1939.) 21*s.* net.

PROF. EVE'S account of the life of his old friend Lord Rutherford treats it in the perfectly straightforward manner which such a book should. He takes the reader steadily through the life from boyhood in New Zealand to the 1851 Exhibition at Cambridge, the chair at Montreal, the chair at Manchester, and the return to Cambridge. A great part of the history is given through the medium of Rutherford's letters, many of the earlier ones being those written to his future wife.

The order of presentation is rather strictly chronological, so that successive paragraphs may deal with entirely different subjects; for example, they may consist in accounts of a public lecture, a holiday journey, the organization of a department, and a new scientific discovery. In describing the purely scientific work, Prof. Eve at intervals devotes a few pages to a non-technical explanation of its import, which should help the inexpert reader in understanding the steady progress of the discoveries in which Rutherford took the leading part. In fact the biography is cast mainly in the form of a chronicle, and this is exactly the form it should have. There will remain for some later historian, who will have gained the perspective and impartiality of time, the task of assessing the respective merits of the enormous contributions that Rutherford made to physics. Taken in conjunction with his published books and papers, the present biography will provide very complete documentation for such a historian, and it should go a long way towards protecting Rutherford from the two dangers to which the lives of the great seem to be specially exposed, on one side the degeneration into a dreary hagiography, and on the other the psychological account of the (usually Freudian) thoughts which the biographer thinks that his subject ought to have been thinking.

With a biography, as with a portrait, the author is always faced with an almost insuperable difficulty, that of satisfying both those who knew the subject and those who did not. The first expect to be reminded at every turn of the living original, whereas the others, with no personal memories, have to build the whole image out of the author's own work. So it is natural to ask whether Prof. Eve has 'got it across'. He has certainly given himself the best chance of doing so by his copious quotations from the letters. These, be it said, are mostly quite ordinary letters, dealing with the happenings of Rutherford's life, such as those written to his family when on a visit to America, or those to friends on the Continent renewing relations after the War of 1914–18. They are good straightforward descriptions of events, not embellished into anything like belles-lettres—had they been so one would have doubted their authorship—and anyone can feel that he *could almost* have written them himself. But not quite, for there is a tremendous common sense about them and a vigour raised to high power, which is the characteristic that his intimates will most remember. But in reading them the intimates will have in mind the associated memories of the general raciness of his conversation, of his amusing reminiscences and the critical but usually kindly comments on his contemporaries. This side of him is very much harder to describe in a biography, because it can only be done by illustrations of a topical kind, and the mere attempt to give them would destroy the lightness which is their essence. It is a matter for briefer treatment than is possible in a book, and we may hope that, before memories fade, there will be gathered together a Rutherford saga, of the kind of which a beginning was made by Tizard's lecture last spring. There are many men, great to their friends but little known to the world, of whom the same sort of thing is true, and usually their memory does not long survive. But here the greatness was combined with an external greatness patent to the world at large. May we not hope that this will just make the difference and lead to the survival of the whole man.

It is impossible to read the life without trying to estimate what the verdict of the distant future will be of Rutherford's various discoveries. Many of them, which in another man would be counted as of the very first class, can be attributed to accurate timing on his part. Rutherford himself used to say, in connexion with some of the wilder speculations of his contemporaries, that no one could see more than an eighth of an inch beyond his nose, and that only a great man could do even that. He had himself just that extra little range of sight beyond the eighth that got him there ahead of the rest. One cannot doubt, for example, that the law of radioactive decay would have been explained by someone else, if Rutherford had not done it a few months earlier. In other cases he got the lead by his capacity for choosing the right one among several confusing alternatives, by his gift for always "picking the right bottle off the shelf". Thus one distinguished man of science would write to him reporting a new type of radiation, and he would be entirely unmoved, correctly attributing the result to some unconsidered impurity, while another would write a very similar letter and he would stop all the other work of the laboratory and Chadwick would discover the neutron.

In the case of some of his discoveries, however, Rutherford was much more than a few months ahead of his competitors. For example, the study of α-particle scattering was undertaken in order to probe into the atom, and the ordinary scattering by electrons did serve to give at least a strong suggestion that the number of electrons was about half the atomic weight; the scattering of a few particles through broad angles was an unforeseen extra gift. It is one of those profitless but interesting speculations to conjecture what would have happened if Geiger had failed to detect those particles, or if, as it would have been almost natural to do, he had explained them away. The nucleus would have had to wait; but for how long ? Atomic number would have been discovered, but it would have been through Moseley's spectra and it would have been only a curious numerical rule unsupported by any theory. Would Bohr have made his theory of the hydrogen spectrum, without the guiding principle that there was a centre of force attracting according to the inverse square ? Probably, but it might have been somewhat later, and the theory, suspect to the orthodox even as it was, would have had a much more difficult passage. After that there would still have been the experiments on collision to repeat, and so it seems likely that Rutherford found the nucleus at least three or four years before anyone else would have done it.

In the discovery of atomic disintegration he was probably even farther ahead of his contemporaries, and he owed this largely to his breadth in insisting on developing technical methods and exploring whole fields, where smaller men are content to solve single problems one at a time. This wisdom went much farther still, for at an age when most men are entirely set in their habits, he showed that he could recognize that his old simple methods were becoming inadequate for the new knowledge, and that he must—and that he could—embark on the elaborate engineering feats of the modern physical laboratory.

The discoveries of the present epoch can be divided into two types, for which a very good discrimination is according to whether Rutherford liked them or not ; the difference can be felt, but it is hard to put it into words in any other way. The nucleus and disintegration were his own, and he foretold the neutron and was in at its birth. He liked Bohr's theory of atomic structure, and accepted the new quantum theory though without much enthusiasm ; perhaps this was because for a time it put the theorists above the experimenters. At any rate, he could welcome Gamow's theory of radioactive change, and Mott's work on the interference of α-particles with helium atoms. But the positron was not to his taste ; of course he accepted it, but the very abstract idea of 'holes' did not fit his habit of thought. Would he have liked the meson ? Probably not. But the most recent discovery of all, the fission of uranium into comparable parts, that would surely have been a discovery which, had he been spared for little more than a year longer, would have been one of the most acceptable to his genius.

C. G. DARWIN.

ELECTRIC CLOCKS

Electrical Timekeeping

By F. Hope-Jones. Pp. xx + 275 + 6 plates. (London: N. A. G. Press, Ltd., 1940.) 10*s.* net.

SOME few years ago, Mr. Hope-Jones brought out his well-known book "Electric Clocks", and I had the privilege which I much enjoyed of writing a notice of it, which appeared in NATURE of October 17, 1931. I am very glad to be enabled again to notice a new book—"Electric Timekeeping"—by the same author. I say a new book because the title is a little different. I think it should be called a new and enlarged edition. "Electric Clocks" came out when it had become generally recognized that the Shortt clock had revolutionized our ideas as to the possible attainable accuracy of pendulum clocks, and when for the first time the uncertainty had been brought down to a matter of a second in a year. There was then full justification for the author, who had himself invented many of the features on which success depended, adopting the role of the high priest and laying down the law as to what is good and what is bad. As anyone who has seen the first would expect, the present work does not falter in this respect.

The author, who has devoted himself to the subject of accurate clock construction for nearly half a century, is so saturated with the subject, and is so familiar with the almost innumerable ways in which the electric current has been harnessed as an aid, that his presentation of the history of the development is almost bewildering in its thoroughness, but there is this which makes his treatment of real value. It is not a mere catalogue of a thousand-and-one devices in chronological order, but a very critical discussion of each showing the valuable original steps which, however, lacked something necessary for real success, or the essential faults in principle which were so common.

In the earlier volume the author led up to what might well be called the perfect clock—or very nearly perfect clock—the Shortt clock. In the present volume the history is mainly a repetition, but much has happened since "Electric Clocks" appeared. The quartz crystal clock, though it had proved its value so long ago as the year 1928, had not then become so well known as it is now, or perhaps had not reached the present high level of performance, which is, I believe, an uncertainty in the rate of one second in two or three years. In 1928, comparisons of Mr. Marrison's quartz clock in New York connected by land line with Mr. Loomis's three Shortt clocks at Tuxedo demonstrated the disturbance of gravity by the moon. Then again the time laid on by the alternating current network in the country, though known as a possible source of accurate time, had not become general as it now is; and in this, by the way, the author appears to have been the first to point out the possibility*. Again, time at sea, which used to be altered daily by the captain when he said "make it so", is now beginning to pass at a variable rate made to fit the easting or westing of a ship on a plan also proposed by the author. These, the Post Office "Tim", and many other things are discussed in the additional matter.

The author may well be pleased to have had the support of the late and of the present Astronomer Royal. These two great authorities have written the forewords to the two volumes, and this is a distinction of which he may well be proud. He is also able to exhibit a frontispiece which itself is an attraction. When crossing the Atlantic to attend a meeting of the Franklin Institute, where he was presented with the much-prized Gold Medal for his share in the development of the Shortt clock, by rare good fortune Einstein was on board. The frontispiece is a 'snap' of the two in earnest conversation autographed by Einstein himself.

It is now nearly fifty years since the author developed that admirable production the synchronome clock, which was a well-deserved success. Relying on the principles which he never tires of preaching, he invented element by element that invaluable instrument. I must mention in particular two of these. The first is the step-by-step dial ratchet which never fails. This is figured on p. 103. It may seem a small thing, but it represents a degree of perfection unknown before. It has the great merit of not being upset even if the ratchet wheel is eccentric or badly divided. The other is the synchronome switch which applies a gravity impulse to the pendulum every thirty seconds. This contains an element of the first importance, a contact which is a really forcible one, that itself transmits the power to lift the gravity arm and thereby lasts only so long as is necessary. This saves battery waste, provides a sharp time signal, and it never fails.

The triumph of the Shortt clock, which after all is based on the synchronome clock, has not caused the author to rest on his laurels. The latter part of the book records one after another of his further inventions. One is a method of synchronizing a light half-second's pendulum depending solely on circular error. This is a beautiful device, and if the synchronizing current is first set for every second it very soon starts from rest and is in proper phase.

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* "Lightning", November 15, 1895.

Another and much less expected invention, if indeed any invention by the author relating to clocks can be considered unexpected, is an alternate current motor of great ingenuity and value. Two microscopic motors of a few mouse-power had hitherto almost monopolized the field. One was the high-speed self-starter, the Warren motor, which can only go one way, and the other the toothed disk lower speed motor, which is not self-starting and which will go either way. Some few weeks ago a public clock was seen to be going backwards and this led to a crowd wondering, I suppose, how long it would be before it would become yesterday again. This might have been due to the man who started it turning the twiddle nob the wrong way. But the author again comes in with an extra slow-speed toothed wheel motor turning once a second with a permanent magnet for the stator. This, he says, is more efficient than the others, which it may well be. I have used the others in other apparatus and determined the mouse-power of each, which was surprisingly large. I should much like to have one of these new motors on which to experiment.

These are only a few of the author's later achievements. They are all so neat and so practical that it is with regret that I am compelled by consideration of space alone to leave them unmentioned.

The book is so well written that in spite of the host of alternative devices described, anyone with a taste for nice mechanics will read it through with avidity and then read parts of it again.

C. V. Boys.

PAPER

Paper and its Uses

A Treatise for Printers, Stationers and Others. By Edward A. Dawe. Vol. 1. Fourth edition revised. Pp. xiv+188+28 plates. Vol. 2: Samples of Papers and Boards. Pp. vii+157 samples. (London: The Technical Press, Ltd., 1939.) 2 vols., 15*s*. net.

TWO factors combine to make the task of reviewing these volumes an easy one. In the first place they represent the fourth edition of a work which may now fitly be regarded as a classic of the paper and allied industries; secondly, until recently the author directed the activities of the laboratories of H.M. Stationery Office. Both of these considerations are in evidence in the contents of the book. The treatment of the subject combines, in fact, that authority which is born of many years of experience, and that absence of errors and minor defects which is so seldom attained before a work has passed through its early editions.

As the author states in his preface to this edition, the fundamental processes of paper-making have not altered in the relatively short period covered by the earlier editions of the book. Nevertheless, a combination of scientific skill and improved craftsmanship has resulted in many advances, both as regards the quality of the product and the rate of output. Such developments are the principal new features of this edition, the up-to-date nature of which is indicated by the fact that it includes subjects such as the purification of pulp by centrifugal methods; the manufacture of 'two-wire' and artificially conditioned papers (which have contributed so prominently to the solution of the problems of high-speed printing); the coating of papers on high-speed paper machines; air-mail papers; and standards of permanence and the factors which affect this important property of paper.

The first section of vol. 1 is a brief but clear description of paper manufacture, and it follows the usual lines. It is, however, the two subsequent sections, which deal with the different kinds of paper and paper-products and their uses, which single out this work from the many others on papermaking. Into the space of some sixty small pages is compressed a wealth of detail based on sound practical experience. Nothing of importance seems to have been overlooked, and few of the multitude of varied products which originate as paper are omitted. The final sections deal chiefly with testing methods and standardization (matters with which the author has been specially associated), paper trade customs, and methods for the interconversion of sizes and weights of papers. Here again the author steers his way deftly through the maze of intricacies and traditional nomenclature with which the paper industry is still encumbered, and which his own efforts towards standardization have done so much to help to remove.

In the second volume are bound up 157 samples of typical papers and boards, together with the appropriate descriptive details. This volume is dated 1929, and it seems rather a pity that the opportunity was not taken to bring it up to date also. In some instances (notably the sensitized cheque paper, foil papers and offset papers) the samples included would not find favour among users as typical of the best of their kind. This comment, however, applies only to a relatively small proportion of the samples, and the value of the volume as a whole (especially to the student, for whom it is primarily intended) cannot be over-estimated.

Since the author has now retired from his official position, this work may be regarded as a parting gift to the industry. It certainly deserves to command an appreciative welcome from an industry already so much in his debt for the years of unstinted and able service he has devoted to it. Julius Grant.

ECONOMY OF A PRIMITIVE PEOPLE

Primitive Polynesian Economy
By Raymond Firth. Pp. xii+387+8 plates. (London: George Routledge and Sons, Ltd., 1939.) 15*s*. net.

THE material upon which Prof. Firth has based his study of primitive Polynesian economy in this book was gathered in the course of his expedition in 1929 to Tikopia, one of the islands of the British Solomons group in the Pacific. A valuable study of the social anthropology of the inhabitants of the island already stands to his credit in a substantial volume. He now turns to an investigation from another point of view—a point of view which is claimed, and justly claimed, to be new, namely, that of the system of values which determines preferences in the satisfaction of needs.

The people of Tikopia, it will be remembered by those who are acquainted with Prof. Firth's earlier book, are virtually untouched by White civilization; and in their mode of life they may be regarded as an example of a people of simple backward culture. When, however, this culture is submitted to examination, it is seen that what may be termed their economy, as thus defined, is by no means simple, but on the contrary is of a highly complex character. It is made no easier of understanding in the eyes of a Western observer by the absence of price and its common measure, money. This absence is, of course, a fact which has not passed unobserved by previous observers of life in other primitive or backward communities; and the differences in standards of value and media of exchange have been the subject of instructive study. Prof. Firth, however, is the first to examine the problem to which it gives rise from the point of view of the functional anthropologist, prefacing his study with a consideration of the general question.

Now it must be clear that the study of the economy of a primitive people may be approached from two very different points of view. On one hand the sociologist, and the observer whose record is intended to meet the needs of a Western audience, will make use of a classificatory system and a terminology based upon concepts which in theory, at least, are abstract and of universal application. The anthropologist, on the other hand, in so far as he aims at an accurate and objective ethnographical record, is concerned with a standard of values that is relative—relative to the culture of the people under investigation. It will be remembered that Prof. Malinowski records a striking example in his account of the system of ritual exchange in the Trobriands in his "Argonats of the Western Pacific", while further examples to which reference has been made are afforded by the refusal of the peoples of Africa to commercialize their cattle, or their reluctance to abandon the use of the hoe for more efficient means of cultivation. It is, however, neglect of this principle of the relativity of any given system of values which has vitiated or caused the neglect of the study of primitive economy.

Applying this principle to the people of Tikopia, Prof. Firth shows how in the instance of food, for example, the bare biological need is transcended by values of a non-nutritional order, as a means of meeting social obligations, the responsibilities of kinship, and other ritual requirements; or again in fishing, it is not the remunerative value of the catch which will determine the direction of effort, but ritual which demands that the first catch should be a shark, rather than the less difficult and more profitable flying-fish. Thus the general trend of this investigation may be summarized as showing that the system of values which it might be argued applies to 'economic man' becomes a matter of social relations, and must be considered in the light of that fact, requiring in the study of primitive economics a profound modification in the usual line of approach.

Prof. Firth has produced a most valuable and stimulating study, which will repay careful consideration, not only by the anthropologist, but also by the administrator and others who have to come into intimate touch with any people of backward culture.

CAN CHRISTIANITY SURVIVE?

The Gospel and the Church

A Study of Distortion and its Remedy. By the Rev. Canon Charles E. Raven. Pp. 256. (London: Hodder and Stoughton, Ltd., 1939.) 8*s*. 6*d*. net.

CANON RAVEN examines the character of Christianity in Apostolic days and also in the early centuries, and shows the serious nature of the distortions that occurred. These are more obvious in the formative period between the second century and the collapse of the Western Empire. There were three directions especially in which the primitive Gospel was abandoned: The renunciation of Nature, the distortion of history and the development of institutionalism. Dealing with the first of these he points to the stress laid on miracles, the craze for which had permeated all classes of society, and as a consequence of this obsession religion was identified with the crudest supernaturalism. The pernicious influence of Jerome in dealing with sex is well known and is shown by his deliberate mistranslation of "almāh" as meaning "virgin" instead of "a young woman of marriageable age", and in many other ways as well. He maintained that both Joseph and Mary preserved their virginity and explained the "brethren" of Jesus by asserting that they were His cousins, children of Clopas or Alphæus and another Mary, sister to the mother of Jesus.

In history the distortion is seen in the almost complete neglect of the Gospel records. With the disappearance of the earthly life of Jesus there arose a multitude of saints, some purely mythical, and through neglect of history religion was largely divorced from life. The loss of the sense of the value of Nature and history implied a change in the quality of Christianity, so much so that during the fourth century "it is doubtful whether we ought to say that the Church conquered the world or that the world invaded and subdued the Church".

In order to explain the persistence of the Church's distortion in regard to Nature and history—and we cannot deny that this distortion is still evident—it is necessary to take into account another condition of its early period, the fixing and form of its organized structure. Owing to the rapid crystallizing of Christian institutions and to the form that they adopted, transitory stages of belief became part of the Church tradition. This subject is dealt with by Canon Raven with consummate skill in Chapter v, "The Church Organic and Organized", and he has no hesitation in attributing the lowering of the spiritual standards in the Christian institutions of the third century to the assimilation of Mithraism. The degradation of the Eucharist is described as one of the most tragic of all the distortions of the Apostolic gospel, but many will wonder whether the description given of the superstitions associated with the Eucharist in the third century is not applicable, in part at least, to large sections of Christendom to-day. If Christian orthodoxy refuses to accept the value of Nature and history—a value inherent in its own basic tenets—can it continue to survive in the environment of modern knowledge?

Two chapters, "The Recovery of Nature" and "The Necessity of History" are constructive; but readers will ask how far it is possible to apply in practice all that is advocated. We are told that if we are to learn the lessons that Nature can teach, "it must be by recovering the sense of its wholeness and its value, the humility and the wonder which science in its conflict with religion too largely lost". Furthermore, it appears that the population outside the churches which has discovered the absorbing interest of Nature can be approached by the churches if they free themselves from a distorted tradition. We are disposed to think that Canon Raven has over-estimated the number of people with the "absorbing interest in Nature". In addition, the form of Christianity that would result from his suggestions would be too emaciated for the great majority of people (we are, of course, considering the adherents of Christian tenets outside Anglicans and Protestant Nonconformists), and many would find refuge in magic, charm, talismans, etc., rather than in a religion largely devoid of the element of mystery. It is certain that Mediterranean Christianity would never assimilate a religion similar to that of the Apostolic days. Again, if we recover a sense of the importance of history, is it possible to believe, remembering the reaction against liberalism from which so much was expected, that a synthetic theology will ensue out of the antithesis of recent years and restore to us the proportion of the faith? Throughout his constructive scheme Canon Raven, in the opinion of the present reviewer, appears to have largely overlooked the strong appeal still made by the pagan elements surviving in Christianity.

The book can be recommended because it contains so much with which all reasonable Christians can agree.

M. Davidson.

WAR AND RECONSTRUCTION*

BY DR. JULIAN S. HUXLEY, F.R.S.

EVERYONE realizes, though with very different degrees of awareness and to the accompaniment of feelings that range from ardent hope to sullen resistance, that this War is bound to be followed by radical changes in the structure of separate societies and the organization of the world. In this connexion, biological analogy is helpful not only in creating a general background against which to envisage the coming change, but sometimes in suggesting detailed points in the new order.

In the first place, biology reminds us that change is the normal (though not the universal) rule of life, that certain aspects of biological change can legitimately be called progress, and that man is biologically speaking a very recent type, whose social organization is still primitive in the extreme when looked at in the light of evolution. The lesson of biology for the resistant conservative is therefore that his resistance to change in general is not only useless but also immoral.

But biology has also a warning for the over-enthusiastic progressive. Biological change has normally (though probably not universally) been a very gradual process. The rate varies considerably as between different lines of descent, and at different periods of the world's history, but the change is normally effected through step-by-step alterations of existing organization. In general, it is as frequent for old organs to be converted to new uses as for wholly new organs to be evolved. The zeal of the revolutionary for getting rid of the old system root and branch is thus likely to be wastefully destructive and in the long run to delay progress.

From the point of view of human biology, what are the chief features of the present time which have altered man's social environment so much that corresponding alterations of social organization are needed to meet them—and which, incidentally, have helped to bring about the War ?

The first is the increase in the efficiency and speed of transport and communications, accompanied by the virtual abolishing of frontier space for expansion. This is forcing the remotest regions of the world into often unwilling interaction. It on the one hand provides a potential basis on which world unity could be built, and on the other makes the lack of that unity more and more disadvantageous.

The second is the increase in the potential of power available to States. This is most dramatically seen in respect of war. Armaments have become many times more efficient during the last twenty years. The result is that war has grown out of scale with its function. During many centuries it operated, wastefully enough, yet with a certain efficiency, in adjusting the variations in the balance of power caused by geographical discovery, economic change, and population pressure. But to-day, both its destructiveness and its expensiveness have got out of hand, and have become wholly incommensurate with any positive results which its agency may help to accrue. This, however, is not the only way in which State power has shot up. The dictator regimes have taken into their own hands the organization of economic power and also of the power of opinion. They are in literal truth totalitarian.

The biological analogy shows that for competing nation-States merely to respond to this challenge by corresponding permanent changes in their own organization (however necessary such changes may be as a temporary measure) would be to court disaster. Size and armament alone lead up a cul-de-sac. The giant reptiles of the Mesozoic included the largest carnivores the world has ever seen, like the Tyrannosaurs, and the most heavily armoured animals, like the Stegosaurs and the Ceratopsians. They answered bulk with bulk, aggressive with defensive warfare. But they were all doomed to extinction as soon as the changing environment gave the insignificant but brainier little mammals their chance. The contraction of the world due to better communications provides the corresponding change of environment to-day ; brain-power spent on devising new systems is inevitably destined to supplant the present armoured monsters of the nation-State era. The only question is whether it shall be now, or after more waste and destruction.

A third fact of the utmost importance in the modern world is the search for a new mystic, a new super-personal driving force. Traditional religion of the supernatural type has lost both ground and grip : the curious materialist-idealist compound which expressed itself in the nineteenth century's belief in the inevitability of progress, in the power of knowledge to mould human nature and produce almost millennial prosperity and peace, has wilted in disillusion. In their place, three great nations have already erected new pseudo-religions, all of them involving the glorification of the State. The most radical is that of Nazi Germany, which uses the race-concept as its mystical basis, while for Italy the mystic is the nation, and for Russia the millennial picture of the truly Communist society, when Government will wither away.

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* Substance of the British and American Association Lecture delivered before the American Association for the Advancement of Science at Columbus, Ohio, on December 30.

In all these cases, however, the mystical driving concept is linked with the national organization of power: and this inevitability has brought a recrudescence of intolerance, persecution, and cruelty which has contributed largely to the final shattering of the belief in progress in other nations. History teaches us, however, that intolerant persecution always arises when an unintelligent mystic doctrine is held with such intensity that the end is deemed to justify the means; and that the persecution will be violent and brutal when the mystic doctrine is bound up with the system of power.

Two by-products of this situation are to be noted. First, the unprecedented refugee problem which it has created—unprecedented partly because of the violence and extent of the persecution, partly because of the nationalist unwillingness of other States to absorb new alien elements; secondly, the distortion of truth which it has brought about, with resultant lowering of the quality of scientific research in the countries concerned. A biological analogy here would seem to be the incredibly small size of the brains of the giant Mesozoic reptiles.

The fourth great feature of the present is the trend away from *laissez-faire* and individualism towards planned organization and collective action. During the period of rapid industrial expansion in the nineteenth century, *laissez-faire* individualism worked well enough, in spite of all its attendant horrors of slums, exploited labour and imperialist expansion. Indeed, it is probable that no other system could have so rapidly mastered the forces and resources of the world. But to-day, like war, it is defeating its own ends and proving unsuitable for its functions. It is proving unsuitable for four reasons; first, because unplanned individualisms, as the world contracts, tend to cancel each other out; secondly, because its basic time-span is too short for many types of projects—the individual demands a return on his money within his own lifetime, or at least for his children. Thirdly, because the agent is too localized; the individual demands a return to himself or to his family, whereas many projects are desirable by making a return to the community in general, through better health, greater taxable capacity, higher standard of living and increased consumption demands, and so on. Fourthly, because it prompts the recurrent vicious cycle of trade boom and trade depression.

Already the world has moved far from simple *laissez-faire*; but the present system is a compromise, and the agencies of collectivized planning are as yet extremely imperfect.

The fifth point is the gradual evening out of world resources in raw material and power. This has been accomplished partly by new methods (for example, utilizable nitrogen from the air instead of from Chilean nitrate beds); partly by artificial substitutes (synthetic dyestuffs; artificial silk; plastics); partly by new transformations of old sources of material or power (motor spirit from coal; hydro-electric power); partly by substituting new raw materials for old (aluminium for heavy metals). The net result has been that, while many inequalities of distribution remain (U.S. helium; Canadian nickel, etc.), the bulk of natural resources is becoming much more uniformly spread over the habitable globe.

The sixth striking feature of our time is the great increase in leisure—some of it in the compulsory form of unemployment and retirement at comparatively low ages. (During actual war, much of this leisure is of course abolished.) The totalitarian countries have made some interesting attempts to provide social organizations for the better utilization and enjoyment of leisure, but so far in other countries the individualistic *laissez-faire* tradition, which tends to regard State-controlled organization as undesirable interference, has prevented any real evolution in this direction.

Seventhly, there is a new approach to colonial problems. Partly this is due to the jealousy of the 'have-nots', a normal phenomenon whipped up to exceptional intensity under the pressure of nationalistic feeling; but in large measure it is due to a new attitude, which has already found expression in the mandatory principle, and to a dawning realization of world unity and the part to be played therein by peoples whose social development has been retarded.

We have drawn one evolutionary analogy—that of the over-armed and under-brained reptiles of the late secondary era. We cannot, however, suppose that the subsequent course of biological evolution will serve as a pattern for the next phase in our own history. This would imply that the over-armed nation-States would disappear and their places be taken by smaller nations more concerned with flexibility and intelligence of social behaviour. This is ruled out by the shrinkage of the world. Do not let us forget that man differs from all other major biological types in consisting of but a single inter-fertile species, in possessing much greater control over the environment, and with the power of forming much larger communities. The only possible climax for such a type is that it should extend over the entire habitable globe in the form of a single community, whatever the organization of that world community may be. All intermediate stages, of racial, tribal, national groups, are, in the long perspective of evolution, inevitably unstable.

But for the immediate future, both biological analogy and historical experience demand a step-by-step advance. Some functions are sufficiently advanced to be put on a world footing without dislocation, while for others the step can only be on to a regional basis. The chief functions which could be stepped up to a world platform are those concerned with primary products and raw materials, with certain aspects of research and of communications, and with sea-power. The chief functions for which we must be content with the intermediate regional set-up are the political, in the broad sense of the word.

Let me amplify this second point first. National culture and tradition, usually combined with language, is the strongest political force in the world to-day. So-called race problems, when analysed, always turn out on analysis to owe their acuteness to differences in culture and economic level which happen to be associated with genetic differences. It is wholly premature to envisage any immediate world-government which could stand up to the tensions introduced by existing differences in national culture. Regionally, however, there is a hope.

The U.S.S.R. has already established a federal system over one-sixth of the world's land area. Pan-America is beginning to emerge. The present struggle between Japan and China could without too great difficulty be forgotten in a Far Eastern federation. Malaya and tropical Africa are destined by Nature to take their place as world regions as their inhabitants progress toward economic efficiency and political self-government. Finally there remains Europe, in the cultural sense of the area where Western civilization arose and where it still flourishes, however impeded by the barriers of nationalism and the counter-currents of totalitarian philosophy—regionally the geographic Europe minus European Russia but plus the Asiatic and African fringes of the Mediterranean Sea.

The most urgent political post-War task is the settlement of Europe. It is here that the greatest number of powerful nationalisms occur, here that they are most crowded, here that the ownership of tropical territories is chiefly concentrated. Geography and history dictate a regional solution for this area, now torn by war. And the War is a civil war, between different representatives of the European tradition—the tradition based on Greece, on the Roman Empire, on Christianity, on representative government, on the spirit of modern science and industry.

Yet the differences between the various nations or groups of nations within Europe are so great, their separate traditions within the enfeebled European tradition so strong, that it would be hopeless to attempt at one bound a full-fledged federal system like that of the United States. On the other hand, a League system, even if confined to Europe, will not be enough; the experiences of the League of the American States prior to their federation reinforces the lesson of the last twenty years. A League system will not work because it is a contradiction in terms: the absolute sovereignty of its member States is irreconcilable with collective action for the benefit of the whole. Some abrogation of sovereignty—in other words some step towards federation—is essential.

What is the minimum degree of federation which would be effective? An executive organ, an advisory organ, an organ of discussion, a training organ, an organ of opinion, a budget, and, in the present state of the world, alas, an armed force. The executive organ would be restricted to a council, in which smaller countries could be represented groupwise. The organ of discussion would be some sort of assembly, not necessarily elected by Western democratic methods, but representing functions as well as regions. For training there is needed some form of international staff college; for moulding opinion back toward unity and away from nationalist separation, a broadcasting service and perhaps a film unit and newspapers and periodicals. The budget might be raised as a percentage levy or in various other ways: the one essential is that it should be adequate in amount —at least a hundred million pounds per annum. Inadequacy of finances was one of the reasons for the failure of the League. The extent of the inadequacy may be seen from the fact that the total of the contributions of member States during any of the last few years was just about as much as what the London County Council spent annually on main drainage alone! As for armaments, if the European council alone disposed of military planes, heavy tanks and heavy artillery (the manufacture of which cannot be kept secret), effective disarmament, both qualitative and quantitative, could be imposed on member nations, and yet Europe as a whole would dispose of a powerful force. The units of the force should presumably be stationed whenever possible in the territory of small nations; that would be an important contribution on their part to collective security.

The budget would be mainly employed, apart from armaments, on long-term development schemes which would not readily attract private capital—partly in Europe (and there mainly in the less-developed nations, though special projects could be contemplated in any country), partly in the colonial dependencies. But a reasonable fraction would be reserved for the other European agencies and for leisure organizations on a European scale.

To these last I shall return. Meanwhile let us consider world organization. The most important of these would deal with primary products and raw materials, and their basic function would be first to iron out the vicious cycle of slumps and booms, and secondly to promote a higher standard of living through higher consumption. The League has been blamed, perhaps rightly, for its lack of proper organization on the economic side. It is, however, fair to remember that in 1919 the machinery for large-scale control of raw materials was virtually non-existent. Most of it was called into being by the great depression of 1929 and subsequent years. It exists in the form of cartels and other international schemes for commodity control. From the technical aspect of economic machinery, these have been much improved during the last decade : it remains to alter their direction, to harness them in the interests of consumption and of the general public instead of permitting the dominance of a policy of restriction and short-term profits for sectional interests. From the technical point of view, the provision of really adequate buffer pools and the wholehearted application of scientific research would also lead to improvement.

They would be under a Permanent Commodities Commission of the League of Nations or whatever world international organization took its place. In addition, such a body would have the duty of canalizing world long-term investments for development purposes, partly in the form of rural loans and the like, partly indirectly through the setting up of development commissions and of what might be called international chartered companies, to promote the general development of backward areas. Development commissions, somewhat on the pattern of the Tennessee Valley Authority, would be suitable for self-governing areas where co-operation can be effected with local government authorities ; while the chartered company type of organization will be needed for dependent (non-self-governing) territories. Such bodies would (as with similar semi-public organizations like the London Passenger Transport Board) be compelled to return all profits above a fixed rate into the area for which they were responsible.

We may take colonies next. Here, as with Europe, the task is to steer a safe course between the Scylla of doing nothing and the Charybdis of attempting too much and seeing the shaky edifice collapse. It is easy enough to say, as many people are saying, that all colonies should be handed over in the immediate future to an international commission. But would it work ? Those who know something about native peoples and the problems of tropical administration say no. There must be somewhere in the system a firm organ of authority and an adequate focus for the loyalty both of those administered and those who administer them. Until the incipient federation of Europe that we have outlined grows into a true federal government, and until training and tradition have produced an *esprit de corps* in the international administrative service, these essential organs of colonial administration will not exist internationally. To take a somewhat remote and yet valid biological analogy, before the adequate development of the cerebral cortex, lower vertebrates had to delegate most of their behaviour to a rather poorly co-ordinated system of reflexes and simple instincts.

The remedy would seem to be retention of the principle of national and executive authority at the periphery, with a reasonable and increasing degree of international non-executive control at the centre. The separate colonies and their administration would remain British, French, Belgian, and so on, though they should all be put on the footing of mandates, and the Mandates Commission strengthened by the grant of powers of investigation on the spot in addition to mere review of policy. Under the European council would be established a colonial commission, truly international, with small but picked international staff of research workers, experts and travelling advisers, and the power of allocating considerable grants out of the European common budget for education, for health, for conservation, for roads and other public works.

It would be desirable that a small but progressively increasing fraction of the technical and perhaps later of the administrative posts in the local service should be thrown open to nationals of other countries ; but the appointments should be in local hands, not in those of the international authority.

A somewhat similar system works quite successfully between the Federal and State authorities in the Tennessee Valley Authority, and it ought to work well enough in the colonial sphere. The scheme would have to be modified in the minor colonial areas, such as the Caribbean and the Pacific, to allow of the participation of other powers, for example, the United States and some of the British dominions.

Do not let us forget that international administration is *per se* no solution of the basic colonial problem, which is the development of the colonial territories and their inhabitants towards self-government. It could only help at the European end, in reducing jealousy among the great powers. But even the partially international scheme set forth above would remove most of the political objections to the transferring of colonial mandates to other powers.

Meanwhile the world organization, too, through its international chartered companies, its world loans, and its expenditure on research, would be aiding in the progress of the tropical countries. The international staff college would have its colonial section, and after perhaps a generation, there would have been built up a truly international *esprit de corps* among the staff.

I mentioned the growth of leisure and the need for its better organization. This is especially urgent in Europe, for it will be largely through such organization that the people of its separate countries will be able to understand the European tradition and to participate in it, only so to experience the greater European loyalty which will render the lesser national loyalties innocuous, a source of local but co-operative pride instead of a source of jealousy and hate.

To do this, the democracies must learn from the totalitarian States ; they must build up their own leisure organizations, and then extend the principle internationally. One can think of so many ways in which such organizations could promote "life, liberty and the pursuit of happiness" on the international plane. Properly organized travel in international parties ; youth hostels, walkers' and climbers' hostels, all over Europe. International festivals like Salzburg in the old days, or Oberammergau, but more numerous and made available to many more people ; an international system of holiday camps, of summer schools, of study and hobby groups, of retreats, dotting Europe from end to end. The whole could easily be linked up with the extension of the exchange system which will be necessary on the educational side—exchange of undergraduates, of graduates, of teachers and professors, to a certain degree of schoolboys ; and also with international schemes of refresher courses for administrators and professional men of every description, and of adult education. One may even envisage the substitution of citizen service for military conscription, and the placing of that, too, on a broad inter-European basis. In all such ways, Europe could become a reality to its inhabitants, and the onward flow of its great cultural tradition would be reinforced.

Let us try to envisage what improvements such changes would bring about. Nationalism and self-determination would not disappear ; but they could be relegated to the cultural sphere, as has been done within the U.S.S.R., and banished from that of economics and power politics. Political boundaries and national Governments would continue to exist ; but their importance, and especially their importance in causing trouble, would be reduced. The risk of conflict between major regions would remain until the time was ripe for world as opposed to regional federation. But the financing of development schemes in the poorer or less advanced countries, and the reduction of economic distress by ironing the bottom out of depressions and by planned schemes for world production and distribution of raw materials and primary products, would remove some of the chief causes of unrest and war.

Friction and difficulty will remain : we have the fundamental biological analogy of hostile symbiosis of the parts within the body to remind us of that. But man and his societies are organisms, albeit with their own unique nature ; and the equally fundamental biological analogy between animal and social evolution shows us that the difficulties can be overcome, and the friction of the parts subordinated to and even utilized for the benefit of the whole.

But do not let us delude ourselves into thinking that it will be easy. Wishful thinking issuing in impractical schemes is one of man's unique biological attributes. Historical experience demonstrates that the most important line of evolutionary progress has been through the improvement of brain mechanism, notably the mechanism for acquiring knowledge and correlating it with action.

The corresponding social machinery is yet in its infancy. The end of the War will face the world with a task for which it is ill prepared. But again, do not let us attempt any ideal or complete plan, any grandiose scheme for which the world is not ripe. That was one of the causes of the League's failure : it was an attempt to impose a ready-made plan, and public opinion was insufficiently prepared for any idea of world citizenship. Rousseau and the Encyclopædists had been preparing opinion for a radical change in society for half a century ; without that, the French Revolution would have been a fiasco. The idea of supernational organization had not penetrated beyond a limited circle of intellectuals, and even they had not had time to work out their ideas in detail, before Wilson sought to impose it in reality. To-day we have at least had twenty years of discussion, together with some bitter if salutary experiences. If the leaders of thought in the various nations can now work out a less pretentious but more workable plan, and at the same time can prepare public opinion for the idea of a dual citizenship, national and world, this War may be the occasion for taking a small but decisive step away from war and towards a world organization of humanity.

CANCER-PRODUCING CHEMICAL COMPOUNDS

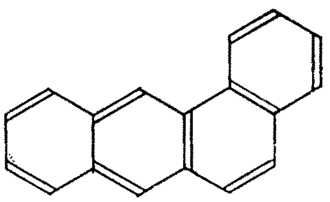
BY PROF. J. W. COOK, F.R.S.,
UNIVERSITY OF GLASGOW

IN the last resort, the degree of importance which is attached to the carcinogenic substances depends upon whether such compounds are concerned in the etiology of 'spontaneous' human cancer. Perhaps closely bound up with this question is another unsolved problem of outstanding importance, namely, the manner in which these compounds bring about a transformation of normal cells into malignant cells. At least until answers are forthcoming to these questions, the carcinogenic compounds will continue to furnish useful material for the experimental study of cancer. Industrial cancer, in its various forms, has stimulated the researches which have brought to light the cancer-producing properties of the various carcinogenic agents, and in the preparation of the present brief survey of these agents regard has been paid to the correlation of the various forms of industrial cancer with their causative compounds.

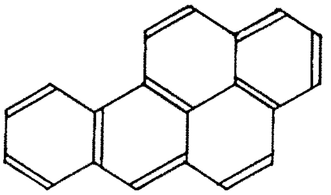
In the earlier work on the carcinogenic properties of substances the skin of the mouse was usually employed as the test object. This was due to a number of reasons. Results could be expected comparatively rapidly; the ear of the rabbit, which had been first used, was less satisfactory in this respect. Moreover, the modes of application of the substances under examination were considerably restricted by the toxic and inflammatory properties of the crude mixtures which it was necessary to use. Many of these difficulties have been resolved by the availability of pure chemical compounds of high carcinogenic potency, and in recent years new techniques of administration have been developed, so that malignant tumours have been induced in a large number of different tissues, and in several different species. One outcome of these and other studies has been the revelation that, in certain strains of animal, tumours of a particular organ are apt to occur spontaneously. Thus, some strains of mice show a high incidence of mammary carcinoma; other strains show a high incidence of lung cancer; and there is at least one strain of mice in which liver-cell cancer (hepatoma) is apt to arise spontaneously. These findings indicate the caution that must be used in interpreting the results when cancers of such organs are found in experimental animals, especially when the tumours arise at sites other than that of application of the carcinogenic agent. Yet even so, tumours clearly attributable to the treatment have been found, usually at the site of application, in a variety of tissues of animals treated with carcinogenic compounds. In this respect the most versatile substances so far found are contained in the group of polycyclic hydrocarbons, mostly related to 1 : 2-benzanthracene (I), in which substituents are present at certain well-defined positions in the molecule. With these compounds malignant tumours have been obtained, usually in mice and rats, in such tissues as the skin, the subcutaneous tissues, the peritoneal cavity, the liver, the prostate, the forestomach, the brain, and the spleen; and this list is not exhaustive. Less widespread in their effect are members of other classes of compounds, where usually carcinogenic action has not been shown except in a single organ. In this connexion it needs to be borne in mind that these substances have not usually been so widely investigated as the polycyclic hydrocarbon class.

The earliest form of industrial cancer, recognized as such in the latter part of the eighteenth century, was the cancer of the scrotum to which chimney sweeps were specially liable. This was caused by soot, and the pursuit of the clue so provided culminated eventually in the isolation from coal tar of the individual compound responsible. This is 3 : 4-benzpyrene (II), an aromatic hydrocarbon, the relationship of which to 1 : 2-benzanthracene (I) is apparent from the formulæ. 3 : 4-Benzpyrene is undoubtedly the principal cancer-producing constituent of coal tar. It has a high boiling point, and hence is present to an appreciable extent only in the highest boiling fractions of the tar. There are grounds for inferring that this or a similar compound is responsible for the carcinogenic properties shown to varying degrees by some of the mineral lubricating oils. Prolonged contact with industrial products of these types is now recognized as being fraught with danger, and the use of suitable precautions should lead to diminution if not to eradication of the form of industrial cancer which they are liable to cause.

The widespread use of tar in road surfaces, and the publication of statistics which appear to show that cancer of the lung is increasing at an alarming rate, have led to the suggestion that tarred road dust may be partly responsible for this increase. This suggestion has been tested experimentally;



(I)



(II)

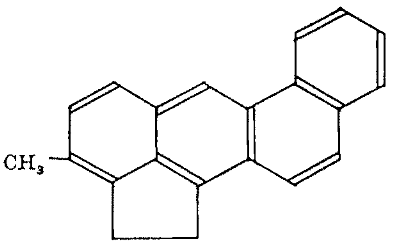
but although an increase in lung cancer was found in mice breathing air impregnated with road dust, this increase was not wholly related to the presence of tar in the dust, and the results of the experiments do not directly implicate such an agent in the increase of the human disease. Furthermore, it is considered by many authorities that the recorded increase in lung cancer is largely accounted for by improved methods of diagnosis. Unconvincing attempts have also been made to implicate pollution of town air by soot, exhaust fumes, etc., and also tobacco smoking in the increase of lung cancer. However, the knowledge that the agencies in question may be, and sometimes are, associated with carcinogenic substances, does not allow such speculations to be too lightly dismissed.

The carcinogenic activity of 3 : 4-benzpyrene is of a high order, inasmuch as tumours arise in a large proportion of the treated animals, in a relatively short time. A somewhat greater potency is shown by 20-methylcholanthrene (III), a hydrocarbon first obtained by chemical transformation of the bile acids, and later indirectly from cholesterol. Other hydrocarbons of similar structure have similar high activity. An altogether higher order of activity, judged by the criterion of shortness of the latent period in the induction of skin tumours in mice, has recently been found in a small group of hydrocarbons typified by 9 : 10-dimethyl-1 : 2-benzanthracene (IV). These compounds, which are characterized by the presence of methyl groups in the positions shown, have in mice skin given tumours which frequently made their appearance within a month of the first application.

It will be observed that the carcinogenic hydrocarbons thus far mentioned are all derived from 1 : 2-benzanthracene (I). A very considerable number of other carcinogenic derivatives of 1 : 2-benzanthracene is now known. These are purely synthetic compounds, not known to be associated with either industrial or naturally occurring products. Their chief interest lies in the large number of closely related compounds which have been shown to have such biological activity, and in the generalizations which it has been possible to arrive at regarding the correlation of carcinogenic activity with molecular structure and with other properties.

The benzanthracene group is not the only group of polycyclic hydrocarbons with carcinogenic properties. Feeble activity is shown by 3 : 4-benzphenanthrene (V), and systematic examination of homologues and derivatives now in progress is pointing to the conclusion that much enhanced activity is shown when suitable substituents are introduced into positions 1 and 2, but not into other positions of the molecule. Before 3 : 4-benzpyrene had been isolated from coal tar, it had been claimed erroneously that chrysene, also a coal tar constituent, had carcinogenic properties. This error appeared to be due to the incomplete purification of chrysene of coal tar origin. These and other circumstances have caused some attention to be devoted to chrysene derivatives, and a number of chrysene homologues, selected in a haphazard way, have been synthesized and found inactive when tested biologically. More recently a consideration of the structural relationship among the carcinogenic derivatives of 1 : 2-benzanthracene and 3 : 4-benzphenanthrene led C. L. Hewett (*J. Chem. Soc.*, in the press) to synthesize 1 : 2-dimethylchrysene (VI), and this hydrocarbon has been found to have definite carcinogenic activity when tested by application to the skin of mice.

For many years it has been recognized that the operatives engaged in certain sections of the



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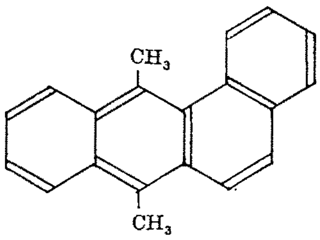
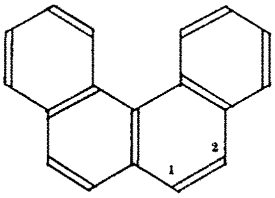


(IV)

chemical industry, and especially in the manufacture of dyestuffs, are more liable to cancer of the urinary bladder than is the general population. This form of cancer was long known as 'aniline cancer', and the prevailing opinion for many years has been that it is due to absorption of nitrogenous bases such as benzidine and the naphthylamines, especially β-naphthylamine. Until recently the evidence was purely circumstantial, and many unsuccessful attempts have been made to induce experimental tumours with these bases. Some two years ago, however, the production of bladder tumours in dogs given, subcutaneously and orally, large daily doses of a high grade of commercial β-naphthylamine was reported by American workers. It was doubtless the prevalence of this dye-workers' cancer, coupled with the known cell-proliferating properties of Biebrich Scarlet *R*, which led to Japanese researches which have shown that a number of relatively simple azo compounds have carcinogenic properties. The principal active compounds which have been revealed by this work are 4'-amino-2 : 3'-azotoluene (vii), which gives liver-cell tumours when fed to rats and mice, 2 : 3'-azotoluene (viii), which gave malignant tumours of the urinary bladder in rats, and *p*-dimethylaminoazobenzene (ix), which is mainly carcinogenic towards the liver.



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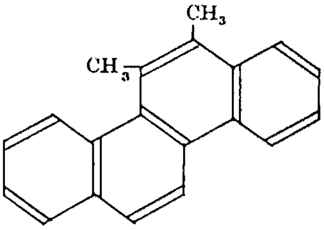
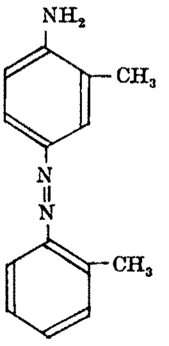


(vi)

In view of the possibility that contaminants of the naphthylamines might be responsible for the dye-workers' cancer, a number of possible transformation products have been administered to rats and mice in the research laboratories of the Royal Cancer Hospital, London. Mice treated with 2 : 2'-azonaphthalene (x) by application to the skin, or by subcutaneous injection, or by feeding, have developed many liver growths, some of them liver-cell carcinomas, but most were of a cholangiomatous type. Similar tumours were obtained with 2 : 2'-diamino-1 : 1'-dinaphthyl (xi), a product which arises easily by intramolecular change of the dihydride of (x), and also with 3 : 4 : 5 : 6-dibenzcarbazole (xii), which is formed by deamination of (xi). There is thus the possibility that the biological effects of this series of compounds are due to a common metabolite, and it is worth noting that the final product of the series (xii) has a structural resemblance to the carcinogenic polycyclic hydrocarbons.



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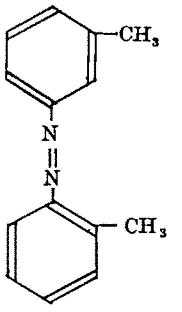

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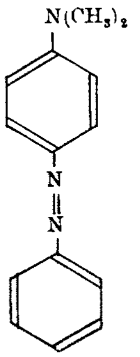
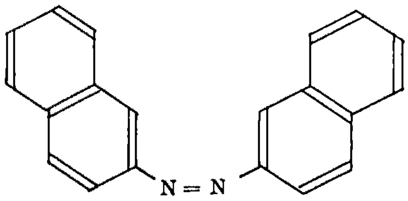


(ix)

One of the azo dyes found to be carcinogenic to the liver by the Japanese workers, namely, *p*-dimethylaminoazobenzene (ix), was formerly used as a food colouring matter under the name of 'butter yellow' and has also been used in dyeing leather. Fortunately, its use in these respects appears now to be obsolete. In Great Britain the range of permitted food colouring matter is now very limited. With the co-operation of the Government Chemist, tests have been carried out in which



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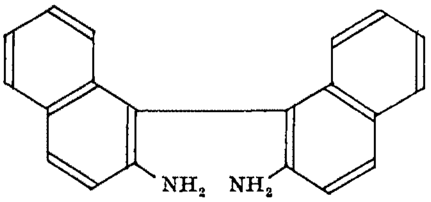

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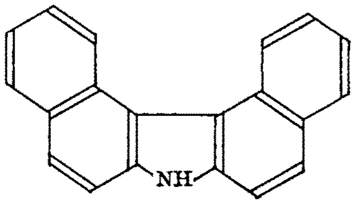

(xii)

relatively large amounts of a selection of these permitted dyes were regularly administered with the food to rats and mice. The compounds chosen were azo compounds bearing some structural resemblance to the azo compounds discussed in the present article. They are mostly water-soluble sulphonates, a circumstance which facilitates rapid elimination. In a few of the mice stomach tumours were obtained; but it is by no means certain that these were due to the dyes.

Existing knowledge of the structures of the various carcinogenic compounds and of the conditions under which they may be formed has led to various speculations regarding the possibility of such substances being present in human food. Some workers have recorded the production of skin tumours by heated fats and by tars prepared by heating coffee. It has been claimed also that wheat-germ oil prepared by a special extraction process produces sarcomatous tumours in rats. This claim has not thus far received independent confirmation, and at the present time there is no evidence that cancer of the internal organs is due to specific dietary constituents. However, it is evident that such lines of inquiry should be pursued.

A puzzling and in some ways disconcerting feature of the carcinogenic agents now known is their variety and their apparent lack of correlation. It may be recalled that cancer may be induced not only by the classes of compound reviewed in this article, but also by several other agencies. The malignant tumours which arise in consequence of exposure to ultra-violet light, X-rays, and radioactive substances may well be due to the production of carcinogenic compounds from normal constituents of the tissues.

There is, however, no evidence that the radiations exert their influence in this indirect manner. Cancer of the skin occurs in persons taking arsenic by mouth over long periods, and has also been found in workmen engaged in handling arsenical sheep dips. Teratoma of the testis in fowls can be induced by injection of zinc salts at the season of the year when the testis is actively secreting androgenic hormone. At other times also this type of growth may be produced if gonadotropic hormone is simultaneously administered, so that at least two factors seem to be involved.

Thus, in carcinogenesis we have a biological phenomenon which may be attributed to a variety of different substances and agencies. This is by no means unique, for the same is true of other biological phenomena; but it is a circumstance which adds to the difficulty of interpreting the biological properties of the carcinogenic compounds and in estimating their ultimate significance.

OBITUARIES

Prof. Sydney J. Hickson, F.R.S.

By the death of Prof. Sydney J. Hickson on February 6 at Cambridge, British zoology loses one of its most distinguished professors. He was born in 1859, and was at Manchester from 1894 until 1926, during which he was identified with every aspect of the development of the University of Manchester. At the same time he annually contributed to the store of knowledge not only by his special researches on the soft corals, but also by investigations relating to water supplies, hospital sanitation, poultry and many local questions.

Hickson was the youngest of a family of nine, most of the older boys of whom were absorbed into the family manufacture of boots and shoes, then situated within the City of London. His parents were of Unitarian stock with advanced social views, and among their visitors he recalled Mrs. Besant, Charles Bradlaugh, Auberon Herbert, Charles Voysey and G. T. Holyoake, the last person in England to be sent to prison for blasphemy. This early intercourse left a permanent impression, and Hickson always remained an advanced Whig in public affairs, taking a particular interest in the Land Values League of Manchester. In contrast he was an 'out and out' Tory in his ordinary life, and a friend recalls his top-hatted, athletic figure on its morning walk from Withington to the laboratory.

Hickson's early education was at the Mansion Grammar School at Leatherhead, a beautiful old domain on the River Mole. Here he followed his brothers and acquired a taste for Nature, as Ray Lankester had done at the same school. In 1893 he entered University College School, passing on to the College in 1876, where he was so enthralled by Lankester's lectures—the courses commenced at 8 a.m.—that the following year he was Gold Medallist. Then he went on to "Barts", but he found conditions "indescribable and terrifying", Klein's course on histology being to him their one redeeming feature. Lankester advised Cambridge, and there in the laboratories of Michael Foster and F. M. Balfour he found his vocation and made many friends, Sedgwick, Haddon, Bullen, Caldwell, Threlfall and many others. He obtained a first class in the Tripos of 1881; but he had already, by dissecting, teasing and the use of the sliding microtome, begun his laborious studies of the eyes of Pecten and Spondylus; each section was removed and mounted separately by hand, for Threlfall had not yet made his automatic microtome. Similar technique was also employed for his now classical research on "The Eye and Optic Tract of Insects", 1885.

In 1882 Hickson became demonstrator to Moseley at Oxford. His interests henceforth were mainly marine and directed towards those sedentary forms of life upon which his professor had done such brilliant work. He was in Celebes for a year, much of it camped on the shore of Talisse Island ; but illness drove him to the higher lands of Makassar, where he studied native life. His results are published in "A Naturalist in North Celebes", which is distinguished by its vivid descriptions of shore life. In 1888 he was deputy professor at Oxford and in the next year accompanied his uncle, Sir Sydney Waterlow (formerly Lord Mayor of London) on a year's tour of Canada, United States and Mexico. In 1890 he returned to Cambridge as lecturer in advanced zoology. Gadow, Harmer and Shipley were his colleagues in these courses—a highly distinguished team, with Sedgwick to lead them. Each lecturer had his own technique and they were equally successful, for each allowed full play to his own psychology. Hickson was the most vivacious. There were gaps in anatomy, relationships and evolution ; but his beasts were 'alive and kicking', to his pupils' obvious interest and enjoyment.

Hickson became Beyer professor of zoology at Manchester in 1894, and to the regret of his friends his gaiety was largely eclipsed by that load of executive cares which are inseparable from the life of a professor of science. He succeeded Milnes Marshall, a brilliant zoologist, but a new broom has always dust to sweep away. A complete reconstruction of the course for medical students was necessary and teaching collections were deficient. The professors repeated their lectures and practicals to strictly segregated women students, and Hickson's refusal to do so brought about the necessary reform. At this time general interest in nature study and in science in schools was almost negligible in this busy commercial part of England. The new professor recognized this as a serious detriment to university work and set himself to remedy it, especially advocating nature teaching and school museums. Indeed, Lancashire's high position in these respects is largely due to Hickson and the public-spirited men who struggled to remove the financial difficulties which separated the schools from the universities.

The newspapers contain reports of numerous open lectures, especially in connexion with the Manchester Museum, and addresses to 'brotherhoods', excursions and discussions. The City Microscopical Society was his especial interest, and in his turn he was president of the Literary and Philosophical Society. He was a protagonist for the woman students, and the creation of their hall, athletic and other activities was largely due to him ; but perhaps he found the most fertile place for his ideals in the development of the Manchester High School for Girls.

On Saturday afternoons Hickson was always to be found on the University Athletic Ground, of which he was the permanent treasurer, often in summer handling a bat. At the same time he was active in all that concerned the governance of the University, being noted for his 'wise' opinions both on the Council and as dean of the science faculty. The growth and happiness of the University was greatly helped by that tradition of hospitality among its professors which his wife loved to foster, little dinner parties followed by good conversation, always humorous. In science it was a distinguished professoriate, including Alexander, Rutherford, Weiss, Elliot Smith, Dixon, Stopford (now vice-chancellor), Perkins, Lamb, Boycott, Reynolds, Loraine Smith and Hopkinson as vice-chancellor.

In 1895 Hickson was elected to the fellowship of the Royal Society, mainly on a series of papers elucidating the relationships of the soft corals (Alcyonaria). These became his chief theme of study for the rest of his life and he was universally recognized as the chief authority on them. His last paper dealt largely with the effect of symbionts and is now in the press. They were, too, the subject of his addresses as president of Section D of the British Association in 1903 and as Croonian lecturer of the Royal Society in 1916. In 1926 he retired to Cambridge. His mornings were devoted to his research, which, if anything, showed increased mastery, while his afternoons enabled him to display one of the best-kept and varied of small gardens, so different from his Manchester essays in horticulture. He was happy in the past and the present, cared for by his wife, who had been his pupil in his earlier Cambridge days. They had two children, one of whom is a child-specialist at Manchester, while the other, as secretary of the Extension Board at Cambridge, pursues an objective which his father at Manchester advocated forty-five years ago.

J. S. GARDINER.

Mr. E. N. Nevill, F.R.S.

MR. EDMUND NEVILLE NEVILL died on January 14 at his home in Eastbourne at the age of ninety-three. His contributions to science were in astronomy, and his first paper in the *Monthly Notices of the Royal Astronomical Society* appeared in June 1873. This paper was entitled "Note on the Possible Existence of a Lunar Atmosphere", in which he suggested that observations of occultations did not disprove the existence of an atmosphere on the moon. Altogether he contributed about fifty papers to the Royal Astronomical Society and until 1888 he wrote under the name of Edmund Neison, after which he reverted to his family name in accordance with the terms of a will.

Although most of Nevill's work was associated with problems in dynamical astronomy, in particular with those connected with the motion of the moon, he carried out observational work as well. In 1876 his well-known book, "The Moon and the Conditions and Configurations of its Surface", was published, and ten years later he brought out a work with the title, "Astronomy, a Simple Introduction to a Noble Science". Among his numerous contributions to the Royal Astronomical Society may be mentioned an important paper in November 1878 which showed that ancient eclipses indicated a greater value of the moon's secular acceleration than the Arabian observations suggested. He showed that it was possible to effect a reconciliation by postulating a term with a period of one to two thousand years and a coefficient three or four times that of Hansen's, and he expressed doubts regarding the existence of tidal retardations in the rotation of the earth. In a number of other papers he dealt with similar subjects, showing the presence of terms in the moon's motion due to the direct action of the planets, the value of the long inequality due to the disturbing action of Mars, lunar perturbations arising from Jupiter, etc. In the last point he was many years ahead of all other workers in the same field. His research in dynamical astronomy was not confined to lunar work and his versatile mind was able to turn to other branches. As one example, reference may be made to an important paper in 1879 with the title "On the General Solution of the Problem of Disturbed Elliptic Motion". An example of his interest in observational astronomy is shown by his work with a Newtonian reflector of 9⅓-inch aperture on the satellites of Saturn. He communicated his results to the Royal Astronomical Society in 1876 and dealt with his observations of Titania and Oberon, which he was just able to observe under favourable conditions.

In 1882 Nevill went to Natal to observe the transit of Venus, and as a result of the interest aroused in astronomy, a semi-public observatory was established through the generosity of certain residents in Durban assisted by the Corporation. Later, when this was taken over by the Government of Natal, Nevill was appointed the first director. Not only did he carry out the ordinary routine work of the observatory, but he also conducted research in his favourite subject and deduced new values for lunar elements. Reference has been made earlier to the results of some of this research. Unfortunately many of his results, including his lunar tables, still await publication. After his retirement from the observatory he does not appear to have done very much work, and the last paper that he contributed to the *Monthly Notices* was in May 1915 entitled, "On the Conjunction of Stars with the Moon, recorded by Ptolemy". He was elected a fellow of the Royal Astronomical Society in 1873 and a fellow of the Royal Society in 1908.

Mr. B. D. Porritt

THE death of Mr. B. D. Porritt, on January 28, came as a shock to his friends despite the long illness that had foreshadowed it.

Mr. Porritt was born of Yorkshire parents in Canada in 1884, and was educated at the Whitgift Grammar School, Croydon; at University College, London, where he graduated in chemistry in 1908; and at Heriot Watt College, Edinburgh. He joined the North British Rubber Co., Ltd., where he was chief chemist in 1912 and research superintendent in 1916. He left the Company in 1920 to assume the directorship of the Research Association of British Rubber Manufacturers, then inaugurated under the co-operative research scheme of the Department of Scientific and Industrial Research.

The chemistry and physics of the rubber industry in 1908 was much more primitive and ill-informed than to-day, and Mr. Porritt had a wealth of problems before him from the beginning. In the early years, he made useful contributions to analytical and testing methods for rubber. This interest continued throughout his life, for in later years he concentrated an enormous amount of fine detail work on the standardization of testing methods, and was a leading spirit in establishing the Rubber Industry Committee of the British Standards Institution.

Observations of a more fundamental nature were made, as early as 1920–21, on the then unsuspected photopolymerization of rubber solutions, and on the role of oxygen in the mastication of crude rubber. Both these subjects have since received much development in other hands.

Another early interest, which he was able to pursue at length for himself, was the study of the surface breakdown of hard rubber under the influence of light. He contributed also many observations on the swelling of rubber in non-aqueous liquids and on the factors influencing that obscure phenomenon. One of his last interests was the production of crude rubber in the form of fine powder, and the utilization of the new product in novel processes.

By way of a hobby, Mr. Porritt was the British rubber industry's historian, and his "Early History" has long been the classic source for all subsequent writers in this particular field.

The story of B. D. Porritt would be quite incomplete without stress being laid on his tireless work in promoting co-operative research. He commenced in and with the Rubber Research Association when the industry's interest was so lukewarm that only fifteen member firms supported the idea; he left it at his death with more than 170 member firms. This progress and success was due mainly, if not wholly, to his untiring efforts in promoting the co-operative principle, and to the sound work of the organization which he built up. His flair for organization, indeed, extended in many directions. He made a notable success of the Rubber Exhibition at the London Science Museum in 1934–35, and was a leading promoter of the Rubber Technology Conference of the Institution of the Rubber Industry in 1938.

He was author of a small book, "Chemistry of Rubber", in 1913, and co-author of the now well-known reference handbook, "Rubber, Physical and Chemical Properties", in 1935.

T. R. DAWSON.

WE regret to announce the following deaths:

Mr. K. E. Heesom, inspector of mines, Sierra Leone, on February 11, aged forty years.

Prof. J. H. Michell, F.R.S., professor of mathematics during 1923–1928, and honorary research professor of mathematics since 1928 in the University of Melbourne, on February 3, aged seventy-six years.

Prof. E. Soler, emeritus professor of theoretical geodesy in the University of Padua, vice-president of the International Association of Geodesy, on January 24.

Prof. Margaret Floy Washburn, professor of psychology at Columbia University, author of "The Animal Mind", aged sixty-eight years.

NEWS AND VIEWS

American Association: New President

DR. ALBERT FRANCIS BLAKESLEE, director of the Carnegie Institution Station for Experimental Evolution, Cold Spring Harbor, U.S.A., has been elected president of the American Association for the Advancement of Science. This election will be welcomed all over the world, because he has a high reputation as a botanist and as a pioneer in more than one line of research, while his genial manner and ever-ready help to all scientific workers are very well known. His early work, in which he showed that only individuals of a fungus species which were physiologically different could take part in sexual union, initiated a large number of investigations into the behaviour of sexuality in the fungi.

Later, in collaboration with a number of workers he had attracted round him, Dr. Blakeslee analysed the cytogenetics of the thorn-apple, *Datura Stramonium.* The discovery of secondary and tertiary trisomics, and the analysis of their constitution by Blakeslee and Belling was a turning point in modern genetics. Studies of tetraploid segregation in Datura, the production of many haploids and novel chromosome types and the analysis of the effect of changes in the chromosome constitution of a plant by Blakeslee are established as classical reference material. More recently he has been a leader in the utilization of colchicine treatment in the production of polyploid forms. Results of economic importance are already being produced, while a neat use of colchicine is being made for the elucidation of sex-determination in plants. Dr. Blakeslee's wide interests are appropriate to the presidency of the American Association.

University of Cambridge Parliamentary By-election

THE recent by-election in the University of Cambridge to choose a successor to the late Sir John Withers in the House of Commons was of unusual personal interest to scientific workers in that the two candidates must be well known to many of them. Prof. A. V. Hill, Foulerton research professor of the Royal Society, formerly Jodrell professor of physiology in University College, London, has been one of the secretaries of the Royal Society since 1935. Prof. John A. Ryle, regius professor of physic at Cambridge since 1935, has had a distinguished medical career in London, and recently completed a four-year term on the Medical Research Council. Both candidates adopted the adjective 'independent', and while Prof. Hill accepted the support of the Cambridge Conservative Graduate Association, Prof. Ryle preferred to style himself 'progressive'. Prof. Ryle's advantage as a Cambridge resident was offset by the fact that Prof. Hill, as a former scholar and fellow of Trinity College, is well known in Cambridge.

The result of the poll was declared on February 24: Prof. A. V. Hill, 9,840 votes; Prof. J. A. Ryle, 5,386 votes. Prof. Hill therefore goes to Westminster as one of the Parliamentary representatives of the University of Cambridge. In his election address, he claimed the independence usually accorded to university members; in addition, he stressed the importance of international co-operation in attacking the problems which will face the world at the conclusion of the War. He also urged the need for bringing science and learning to bear on national affairs, and said that "science has still too little influence on higher policy in government, in departments and in industry". As regards the universities, their strength must be maintained; industry will require new methods and materials in the recovery phase; improvements in public health must be studied; trained and critical young minds will be needed to meet the problems of reconstruction; and finally, the "free pursuit of knowledge for its own sake must be kept up". Prof. Hill's programme is comprehensive, but no one who knows him will doubt that he will press his views at the proper time with skill and vigour.

Heinrich Wilhelm Matthias Olbers (1758-1840)

ON March 2 a century ago, the city of Bremen lost its most distinguished citizen, the physician and astronomer Heinrich Wilhelm Matthias Olbers, who died at the age of eighty-one years, after a life of unremitting industry. He was born on October 11, 1758, at the village of Arbergen, near Bremen, where his father was pastor, and from his boyhood he was an enthusiastic student of science. When nineteen he became a medical student at Göttingen and at twenty-three set up in practice in Bremen. A conscientious practitioner, he served his fellow-citizens in many ways, and after his death his statue was erected in the city. His astronomical work was done in the upper part of his house in the Sandgasse, which was fitted up to afford a view of the greater part of the sky. His instruments included a 5-ft. Dollond refractor of 3¾-in. aperture, a 5-ft. reflector by Schröter, a quadrant by Bird and a Troughton sextant. It is said that he never slept more than four hours at a time.

Olbers is chiefly remembered for his discovery of asteroids and his fifty years' study of comets. In 1772 Bode had discovered the law of planetary distances bearing his name, and when in 1781 Herschel discovered Uranus it was concluded that there was a planet between Mars and Jupiter, and largely through Von Zach, in 1798 a party of astronomers met at Gotha to start a search for it. Another meeting took place at Schröter's observatory at Lilienthal, and zones of search were assigned to twenty-four astronomers. One of these astronomers was Piazzi of Palermo, but before instructions reached him, on January 1, 1801, he discovered the minor planet Ceres. The search being continued, Olbers, on March 28, 1802, discovered Pallas, on September 1, 1804, Harding discovered Juno, and on March 29, 1807, Olbers discovered Vesta. The fame of Olbers spread far and wide. He represented Bremen at the baptism of Napoleon's son the King of Rome in 1811, and during 1812–13 was a member of the legislative body in Paris. The Royal Society elected him a foreign member in 1804, and the Paris Academy of Sciences in 1829 made him a foreign associate. He was the correspondent of nearly every astronomer in Germany, and through him Bessel became known in the scientific world. Indeed he declared that his discernment of the genius of Bessel was a greater service to astronomy than his own work on comets and planets. He was a man of lovable disposition, generous and unassuming.

Laurent Théodore Biett (1781-1840)

DR. LAURENT THÉODORE BIETT, a celebrated Paris dermatologist, was born in 1781 at Schams, in the Grison canton of Switzerland. Seven years later he moved with his parents to Clermont-Ferrand, where he commenced his medical education under Bonnet, the senior surgeon to the Hôtel Dieu. At the beginning of the century he came to Paris, where he qualified in 1814 with a thesis entitled "Quelques Observations sur la frénesic aiguë idiopathique". Shortly after qualification he was appointed physician to the Hôpital Saint Louis, where he carried out some important improvements, including the establishment of an out-patient department for diseases of the skin, of which he was the director for sixteen years. While attending a patient in London in 1816, he took the opportunity of studying the work of Willan and Bateman, and on his return to Paris endeavoured to introduce their classification of skin diseases, which was in opposition to that drawn up by his friend Alibert.

Biett made many valuable contributions to the treatment of skin diseases, including the use of iron and arsenic internally, the employment of sulphur baths and the application of dry and hot air. His lectures, which were edited by Cazenave and Schedel, appeared in 1828, went through three editions, and were translated into English in 1842 by T. H. Burgess. He also contributed many articles to the "Dictionnaire des sciences médicales", and all the articles on diseases of the skin to the twenty volume "Dictionnaire de médecine", in addition to papers in periodical literature such as the *Bulletin de Thérapeutique*, *Gazette des Hôpitaux* and *Journal universel des sciences médicales*. Being a devotee of the arts, he was the medical attendant of many well-known painters, sculptors and actors. He died of heart disease on March 3, 1840.

Colonial Development and Scientific Research

PUBLICATION of the recommendations of the West Indies Royal Commission together with the important statement of policy on colonial development and welfare (H.M. Stationery Office. Cmd. 6174, 6175), to which Mr. Malcolm MacDonald, H.M. Secretary of State for the Colonies, made reference in the House of Commons on February 20, mark a momentous enlargement in scope in the administrative and financial relations between Great Britain and her colonial and other dependencies of analogous status which will have a profound effect on their future. The measures which the Government now proposes after an examination of Colonial problems which had been begun sometime before the outbreak of the War is an acceptance of an obligation which has long seemed inevitable to those who have been engaged in the scientific investigation of conditions in these dependencies if Great Britain's responsibility is to be met.

In brief, the proposals are as follow : The place of the Colonial Development Fund, instituted in 1929, and limited to a sum of £1,000,000 a year, will be replaced by a greatly increased provision for development and welfare. The sum will amount to not more than £5,000,000 a year for a period of ten years, at the end of which period this provision is to be reviewed. The amount thus made available, is not, however, from one point of view the most important enlargement. On one hand, assistance will no longer be granted, as hitherto in the main, solely to capital expenditure, but recurring expenditure will come under this provision. On the other hand, while certain purposes of expenditure have not been ruled out in terms, assistance has been granted generally to material development. In future this will not obtain ; and such services as agriculture, health, education and housing will be brought into the account.

Nor are the claims of the important question of research overlooked. Hitherto, as Mr. MacDonald pointed out, the Colonial Office has been able to call upon the assistance of scientific and technical experts in dealing with Colonial problems. This service will now be placed upon a permanent basis by the institution of a Colonial Research Advisory Committee, while for dealing with its recommendations a sum of £500,000 a year will be allocated. This will be used to assist in the various fields of research. As already mentioned, these proposals apply not only to the Colonies and Protectorates, but also to the Mandated Territories. The pause, which, as Mr. MacDonald intimated to the House of Commons, must ensue before they can come into full operation, will give the necessary breathing space for the careful preparation of plans.

Tibetan Coronation

IT is perhaps not surprising that, even amid other and insistent preoccupations, the accounts of the final act of the installation of the new Dalai Lama sent by correspondents to the world's daily press, have created a profound impression. Nowhere else, except possibly in Japan, could the inauguration of a new head of the State have so closely wedded the spiritual and the political and civic elements in what is virtually an act of coronation, and at the same time united every member of the population in an expression of combined loyalty and religious fervour.

Throughout the pageantry, the wealth and splendour of display of personal adornment, dress, and equipment vividly described in, for example, the dispatches of the correspondent of *The Times* in the issues of February 23 and 24, there is apparent an all-embracing current of mystic symbolism which endues every act, every movement and every attendant circumstance with the significance of worship, and of recognition of the spiritual influence which centres in and emanates from the person of the reincarnated head of the Tibetan spiritual and political hierarchy. It is this, and not the fact that such ceremonial has not been enacted in Lhasa for the space of sixty years, which animated the crowds through which the Dalai Lama was carried in his golden palanquin to the Potala, and on the following day added a solemn meaning to the blessings of a child conferred on the elders of church and State and later sanctified what was otherwise an unseemly scramble for the Dalai Lama's food as a re-enactment of the ancient ritual of sharing in the flesh of the sacrificial victim.

Relics of the Buddha

BUDDHISM of another order, but nevertheless of a closely related world of thought, appears in the announcement that Buddha relics of exceptional sanctity, discovered in Central India nearly ninety years ago and since in private possession in England, will now return to the East. They have been given to a Buddhist Temple in Ceylon by Mrs. Leslie Smith and Mrs. Winifred Burrows, granddaughters of General F. C. Maisey, by whom they were discovered when with Sir Alexander Cunningham he was investigating the numerous Buddhist monuments around Bhilsa in 1851. The discovery, as described in *The Times* of February 27, consisted of a relic casket—a small crystal tope, with terrace, plinth, hemispherical dome, square pedestal and a double pinnacle, this last forming the stopper of a small perpendicular shaft. This casket has been dated at about 350 B.C. The relic chamber at the bottom of the shaft contained minute pieces of bone, the whole being enclosed in a red earthenware box, which also contained other pieces of bone, and a series of the seven precious things usually accompanying the relics of an eminent person, namely, thin round pieces of gold, a bead of garnet, a crystal bead, two beads of pale greenish crystal, and some minute fragments of pearl.

The casket is now in the India Section of the Victoria and Albert Museum, South Kensington; but a cast and photographs have been supplied by the authorities in order that a replica may be made in Ceylon by native craftsmen. The relics and the seven precious things, which were retained by General Maisey when he presented most of the antiquities to the Museum, have now been enclosed in a carved silver tope from Ceylon for their conveyance to the island.

Sutton Hoo Burial a Cenotaph?

IN an account of the excavation of the Sutton Hoo ship-burial and of the associated antiquities delivered before the Society of Antiquaries of London on February 22 (see NATURE, Feb. 10, p. 231), Mr. C. W Phillips referred to the remarkable feature of the deposit that it did not accompany a body. The explanation which he put forward on certain grounds was that the mound and its contents as a whole had the character of a cenotaph for a great man whose body could not be recovered, possibly through being lost at sea. One suggestion which has been offered. namely that it may have been a measure of insurance on the part of a recently Christianized pagan in an endeavour to make the best of both alternatives, is perhaps not to be taken seriously. Nevertheless survival of a pagan ritual, even in such an essential rite as burial, cannot be ruled out entirely; and it receives a certain amount of support from the archaic character of the ship, of which some further account was given.

The excavation of the ship was under the direction of Lieutenant-Commander J. K. D. Hutchinson of the Science Museum, South Kensington. It proved to be a remarkable vessel in the form of an open barge, clinker-built, keel-less, and propelled by at least thirty-eight oars. It was described as a development of a type already known to archaeologists, and, it may be supposed, of a type already archaic at the time of its burial. In its character as a royal barge, a comparison was instituted with the position of the royal yacht *Victoria and Albert* among contemporary shipping. This view would accord with the interpretation of the find which emphasizes its highly ceremonial nature. At the same time it may be recalled that ship models found by the Danish Thule Expedition to Greenland pointed to Norse ships still being in use of which the essential features had remained unchanged for a period of nearly six hundred years.

Cosmic Rays

THE twenty-fourth Guthrie Lecture of the Physical Society was delivered by Prof. P. M. S. Blackett on February 26. He took as his subject "Cosmic Rays: Recent Developments". He said that the most important discovery of recent years in the field of cosmic rays was the realization that the hard or penetrating component of the rays consists of particles of a new type, called mesotrons. This new particle has a mass intermediate between that of the electron and the proton and possesses the peculiar property of being spontaneously unstable. Its average life when at rest is about one millionth of a second, but when moving fast it lives longer—thus giving a nice verification of Einstein's principle of relativity.

The rays incident on the earth's atmosphere are of very great energy. Recent work shows that some of the rays have an energy certainly as high as one thousand million million volts. This is an astonishingly great energy, and it is probably not the limit. It is quite likely that rays exist with energy as high as a million million million volts or even more. Particles of such great energy have very peculiar properties. Instead of producing a narrow track of ionization a fraction of a millimetre broad like normal atomic tracks, they make a track many metres broad. This is deduced from relativity theory, but has not yet been verified experimentally. Great interest is attached to the 'spectrum' of the rays incident on the earth's atmosphere, since they should give some light on a possible origin for the rays. It is rather remarkable to find that the spectrum of the rays can be represented roughly by a simple power law over a range of energy of above a million to one. More precisely, the number of rays with energy greater than some given value is roughly inversely proportional to the square of the energy, over the energy range from a thousand million to a thousand million million volts. It can scarcely be doubted that this remarkable law must have some profound, but at present unknown, cosmological significance.

Fuel in Science and Practice

THE monthly periodical *Fuel in Science and Practice* has completed eighteen volumes since it was launched as a supplement to the well-known mining journal *Colliery Guardian.* It was established on the initiative of the Coal Research Club in order to provide a medium of communication for those interested in the scientific study of fuel, and coal in particular. It was the first journal of its kind in the English language and has proved very successful, the success being doubtless due in a large measure to the efforts of its first editor, the late Prof. R. V. Wheeler. The first number of the nineteenth volume has now appeared under the editorship of Dr. R. Lessing, who has been associated with the venture since its inception. This, it may be taken, will ensure continuity of policy. It will continue to aim at providing a clearing-house for the results of investigations and a bridge between the science and practice of fuel technology.

The Institute of Fuel has decided to adopt *Fuel* as its research journal for the benefit of its members who wish to be kept informed of the results of recent investigations into coal and other combustibles. The Coal Research Club, assisted by an editorial committee, will continue to direct its policy and ensure the maintenance of its old and successful traditions. It seems probable that the importance of fuel technology for some years to come will ensure a prosperous future for this journal. At the same time, it is pertinent to recall the unsatisfactory state of the documentation of science. While it appears relatively easy to publish journals containing interesting articles, the thankless task of publishing systematic abstracts is a growing burden the support of which meets steady reluctance.

Coal-Gas and Fuel Research at Leeds

PROF. D. T. A. TOWNEND, who succeeded Prof. J. W. Cobb as head of the Department of Coal-gas and Fuel Industries and Livesey professor in the University of Leeds, has now issued his first report, covering the session 1938–39, to his Advisory Committee. He takes an opportunity therein to pay a tribute to the late Prof. Smithells, who died during the term under review and who was a member of the Committee from the time of its formation. To him also was due, more than to any other man, the formation of the Fuel Department in the University and, a few years later, the establishment of the Livesey chair by subscriptions from the gas industry.

In the body of the report, Prof. Townend reviews in turn the varied activities of his department, which has developed in several directions, not only fuel and gas engineering, but also the cognate subjects of refractory materials and metallurgy, in both of which teaching and research have made much headway. A post-graduate diploma in fuel and refractory materials has been instituted along similar lines to those already given in gas engineering and in fuel and metallurgy. The first opportunity will be taken to give a more systematic course in chemical engineering, which is, in effect, so largely the subject of the departmental teaching. Research continues to be supported by the gas industry and the Iron and Steel Institute. Prof. Townend is continuing work on flame, which had engaged him in London, and independent research work carried out by the staff and students continues to be a marked feature of the departmental activity.

Modern Colour Printing

IN the *Electrical Review* of February 2, an illustrated description is given of some of the new equipment installed by Geo. C. Caster and Co., Ltd., commercial and colour printers, who recently transferred their works to Cromwell Road, Peterborough. In accordance with modern practice the factory has been set out on a single floor, with a planned layout for the speedy handling of work and an uninterrupted continuity of production. There is no shafting, and individual direct electric drive is employed on all machines. One of the large high-speed letterpress machines is a two-revolution Miehle capable of a maximum output of 3,000 sheets, 25 in. by 40 in., per hour. Another large two-revolution machine takes bigger sheets (30 in. by 40 in.) and can print 2,300 sheets per hour. For small sheets up to 13½ in. by 20 in. vertical Miehle machines are brought into service. These are specially suitable for high-class colour printing. A maximum of 4,500 prints an hour can be handled by each machine.

The use of a general lighting system of high intensity throughout the factory makes local lighting unnecessary (except under the machine boards). In the composing room an illumination intensity of 35 ft.-candles at the working plane is obtained with Benjamin reflectors, which are also used in the binding department to provide 10 ft.-candles. To facilitate the matching of ink colours, daylight reflectors have been installed in the machine department to give 14 ft.-candles.

The Achromatic Lens

THE contributions made to *Lychnos* during the last two years by Drs. N. V. E. Nordenmark and J. Nordstrom dealing with the invention of the achromatic lens and the part played by S. Klingenstierna, professor of mathematics at the University of Uppsala, in the process, have been issued as a pamphlet by Almquist and Wiksells, Uppsala, with an English summary. Many of the original documents bearing on the history of the invention are reproduced with illustrations. One of the most important is Ramsden's Royal Society paper of June 18, 1789, from which it appears that Chester Moor Hall had an achromatic object glass ground for him in 1732 or 1733 and that achromatic telescopes were made for him by the Strand optician J. Bird. The patent for the construction of such lenses from crown and flint glasses was taken out in 1758 by J. Dollond but no calculations were given, probably owing to the desire to keep the theory from other opticians. Klingenstierna worked out the theory, published it in the Transactions of the Swedish Academy in July 1760 and sent a copy to the Royal Society, which published it, although Dollond stated that it contained nothing which he had not done himself previously.

Early Agricultural Tractors

MR. R. H. CLARK, in the *Engineer* of February 2, under the title "Some Early Burrell Engines", recalls an almost forgotten chapter in the development of steam traction engines, built mainly for agricultural work. In 1846, James Boydell took out a patent for his "Endless Railway", and eight years afterwards patented improvements on it. His ideas were taken up by Charles Burrell and Co., a firm of country engineers established at Thetford in 1770, and in 1856 the first road locomotive was constructed embodying the principle of the "Endless Railway". The general arrangement of the traction engine was much as that familiar a few years ago, but each of the wheels, instead of running on the surface of the road or field, ran on a series of flat shoes which in succession were brought into position by links and pins attached to the wheels. There were six shoes to each wheel.

This arrangement of shoes allowed the engine to move over the roughest roads and over soft and marshy ground. One of the illustrations shows an engine drawing four two-furrow ploughs. In 1857 a Boydell engine drew a load of nearly 44 tons from Bury St. Edmunds to Woolwich Arsenal at an average speed of 3·1 miles per hour. The cost of transport was 2*d*. per ton per mile against 6*d*. if horses had been employed. Boydell engines were apparently being built up to 1868, when they were abandoned for engines with ordinary wheels.

Prevention of Diphtheria by Immunization

ABOUT 60,000 cases of diphtheria, chiefly among children less than fifteen years of age, are notified annually in England and Wales, with some 3,000 deaths. Yet it has been shown, particularly in certain cities in Canada and the United States, that by artificial treatment or immunization the disease may be practically banished. The Minister of Health has therefore issued an official memorandum urging that artificial immunization should be undertaken by county councils and sanitary authorities (Memo. 170/Med. H.M. Stationery Office. 1*d*. net). It is suggested that the immunization should be undertaken as early in the child's life as is practicable and should form an integral part of the work of child welfare centres. The Memorandum gives technical details of the procedure and of the various forms of diphtheria prophylactic used, and of the need for Schick testing after treatment to ascertain whether this has been successful.

Lice

THE Minister of Health has recently issued a "Memorandum on the Louse and How to Deal With It" (Memo. 230/Med., 1940). Its publication comes at an opportune moment, when experience of evacuation has brought the louse problem into prominence. In the event of serious air raids large bodies of people may have to be removed to other districts. This, in itself, is liable to cause the spread of lice to localities, or among people, previously free from infestation. Ample powers are available under the Education and Public Health acts for the application of suitable control measures, and it is to be hoped that public medical officers and other officials will do all possible to reduce what has long been a standing menace to proper living conditions. Copies of the memorandum may be purchased directly from H.M. Stationery Office, or through a bookseller, price 2*d*. net.

Vitamin E

REFERENCE was made in NATURE of December 16, 1939, p. 1008, to a solution of vitamin E now available commercially. Glaxo Laboratories Ltd. put on the market in 1933 capsules of wheat-germ oil extract (thirty times as potent in vitamin E as wheat-germ oil itself). The capsules were given the name 'Viteolin' in 1937. Viteolin was the preparation used by Currie and M'Gonigle in their published clinical trials which confirmed in Great Britain the value of vitamin E in the treatment of habitual abortion. With the availability of vitamin E as a chemical substance (tocopherol) each 'Viteolin' capsule has been standardized to contain the vitamin E potency of 6 mgm. of tocopherol, the potency clinically established as the desirable daily dosage.

Institute of Physics and Freedom in Science

THE Institute of Physics has sent the following letter signed by its president, Prof. W. L. Bragg, to the Polish Ambassador: "On behalf of the Board of the Institute of Physics I have to convey to you, and through you to your Government, the deep sorrow with which British physicists at home and overseas have heard of the forcible closure of the Institute of Physics in Warsaw, the dispersal of its eminent staff and the confiscation of its valuable equipment. Our sympathy goes out to our Polish colleagues in this interruption of their labours for the progress of our science, and in the tragic and unmerited hardships and perils which they are enduring. We look forward to the time, which we pray may not be far distant, when, restored to its former freedom, the Institute of Physics in Warsaw shall once again take its place among the great scientific institutions, and continue its work for the advancement of learning, and the welfare of mankind."

British Museum (Natural History)

IT has been decided that the British Museum (Natural History) shall be open to the public every afternoon from 1 until 5 p.m. beginning on February 28, and it is intended after Easter that the Museum shall be open all day from 10 a.m. until 5 p.m. Certain galleries only are available, and the present restrictions will continue to apply to the number of visitors and to the admission of children unaccompanied by adults.

The Department of Botany has received about seven thousand specimens as a result of an expedition to the Outer Hebrides (Lewis and Harris) organized during the past summer by Miss M. S. Campbell. Miss Campbell was accompanied by Dr. J. W. Campbell, Mr. C. V. B. Marquand, and Messrs. A. J. Wilmott, E. B. Bangerter and J. A. Crabbe of the Department of Botany. The collection is fully representative of the summer flora of the areas visited. Dr. R. Scott Russell has returned from a botanical expedition to the Karakorum Himalayas. The expedition, which would otherwise have continued into 1940, was cut short by the outbreak of war and only the collecting planned for 1939 was carried out. The number of gatherings made was 870, and the specimens collected have been left at Kashmir to be forwarded to the Museum later.

Earthquakes in Turkey

ACCORDING to a *Times* message, the final official figures for the Turkish earthquake of December 26 are 32,741 killed and 9,404 injured. It is also reported that it has been decided to rebuild Erzinjan slightly to the north of the old town and that construction is beginning.

Aftershocks of the earthquake still continue with considerable severity. Between 3 a.m. on February 21 and noon on February 24 another 300 people were killed, many more injured, and more than 10,000 head of cattle perished in addition to six villages being completely destroyed. The earthquakes commenced about 3 a.m. on February 21, and before 5 a.m. there had been eight severe shocks. The epicentres appear to have been near the village of Soysalli, near Kayseri in Central Anatolia, some 150 miles south-east of Ankara. Soysalli and three other villages were completely destroyed and the shocks were sufficiently intense to have been felt in eleven districts and many towns, including Ankara, Istanbul, Smyrna, Konya and Adana. On February 22 there were six more shocks and on February 23 and 24 the shocks continued with decreasing severity. In spite of the intense cold which still prevails in this part of Turkey, many people are preferring to live in tents.

Problems of the Industrial Scientist

A CONFERENCE on "The Problems of the Industrial Scientist" convened by the Association of Scientific Workers and the British Association of Chemists, will be held on March 9, commencing at 2 p.m., in the lecture hall of the Pharmaceutical Society, 17 Bloomsbury Square, W.C.1. All scientific workers and others interested are cordially invited to attend and participate. Prof. F. G. Donnan will be in the chair Mr. Hugh Linstead, of the Pharmaceutical Society, will open the proceedings with a general survey of the problems of scientific workers employed in industry. This will be followed by a series of short papers and discussions. At the conclusion of these discussions, Prof. J. D. Bernal will sum up the discussion as a whole, and the conference will then consider the possibility of adopting a 'programme' for scientific workers in industry. Similar conferences are being held at Liverpool, at 6.30 p.m., on March 4, at 5–6 Bluecoat Chambers, Liverpool, 1; Manchester, at 3.0 p.m., on March 16, in the Chemistry Lecture Theatre, the University; Birmingham, date to be announced later. Following the regional conferences, it is intended at a later date to hold a National Conference to review the data and resolutions resulting from them, and to decide on the final form of the 'programme' and on steps to be taken to work for its acceptance. Further information can be obtained from the Secretary, Association of Scientific Workers, 30 Bedford Row, W.C.1.

Announcements

THE British Association is arranging a conference on "Science in National and International Aspects", to be held at Reading during July 24–26. This will take the place of the ordinary annual meeting which would in normal circumstances have been held at Newcastle.

MR. ASA BINNS, until recently chief engineer of the Port of London Authority and now a consultant to the firm of consulting engineers, Messrs. Rendel, Palmer and Tritton, has been elected president of the Institution of Mechanical Engineers for the year 1940.

DR. LOUIS MARTIN, director of the Pasteur Institute of Paris, has succeeded General Sieur as president of the Academy of Medicine of Paris.

THE Council of the Royal College of Surgeons of England has undertaken to organize a library at the medical base in France for the use of the officers of the Royal Army Medical Corps.

THE Oxford Ophthalmological Congress will be held at Oxford on July 4–6. Prof. Le Gros Clark will deliver the Doyne Memorial Lecture, and there will be a discussion on "Emergencies and Complications of the Operation for Cataract".

THE Board of Education has just published a "Handbook of Suggestions of Health Education" (H.M. Stationery Office. 6*d*. net). The book is issued primarily for the benefit of teachers, and covers most aspects of health education, and incorporates recent advances in the science of nutrition.

ERRATUM. Letter by Dr. D. Roaf entitled "Energies of β-Particles from Uranium-X_2" in NATURE of February 10, p. 223, the numbers along the $H\rho$-axis in Fig. 2 should read: 0, 5000, 10,000.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 351. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radium Treatment

SIR LEONARD HILL returns in NATURE of January 27, p. 151, to his statement "that we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there", and seeks to make good this assertion by reminding us of some of the casualties of radiological practice. He has allowed these examples to stay in the forefront of his mind, instead of fitting them into the groundwork of experience, which every practising radiologist must do.

The dangers attending the use of radium and X-rays have been the concern of the X-ray and Radium Protection Committee for many years. No Committee can possibly safeguard a patient against an unskilful application of rays, but radiologists have striven to limit such dangers by making a real specialty of their subject; and there are at present five universities or kindred bodies in Great Britain which grant medical diplomas in this subject. The subject has, indeed, reached a status where its exponents can afford to ignore the rather baser charges in question, but the dis-service of Sir Leonard is to the public, who pay undue attention to his *ex cathedra* statements.

It is not true that the 15,000 patients (mostly cancer patients) who received radium treatment in Great Britain during the year 1938 had such treatment because of the vested interests of the medical public; the vast majority had radium treatment because it was considered the best available for them. It should be remembered that more than 90 per cent of the country's radium is held by big organizations, such as the Radium Commission, the King's Fund and the Medical Research Council; this is some guarantee that it is used by people of responsibility.

Sir Leonard would like to see "the use of radium or X-rays being reserved for one or two places in the body where surgical operation is very difficult". The publication "Medical Uses of Radium" has been issued yearly since 1922 by the Medical Research Council, and the Radium Commission has in recent years made annual reports on the results of treatment; from them the pertinent fact emerges that the medical profession continues year by year to treat various forms of cancer at many sites of the body, and there is a disposition to widen rather than restrict the field. As for radium in the boreholes, it is only right that the public should know that much of the radium put away for safety has now been brought into use for their treatment.

SIDNEY RUSS.

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Feb. 6.

SIR LEONARD HILL writes, in NATURE of January 27, with reference to radium treatment and expresses a belief that "we would be little the worse off if all the radium now buried in deep holes for security from bombing remained there. . . ." This pessimism contrasts notably with the enlightened optimism of the article, in the same issue, written by Dr. John H. Lawrence, of the University of California, who is working with great opportunities at present lacking in Great Britain. Lawrence and his co-workers are pursuing "the possibilities of artificial radioactivity and neutron rays in cancer therapy until a more satisfactory answer to this problem has been reached". What we require in Great Britain is a well-organized radiological institute where the various possibilities of radiation can be developed and extended. It had always been my hope and ambition that such an institute would be founded as a memorial to Lord Rutherford, who was always wide awake as to the possibilities of radiotherapy and the proper means by which they could be furthered or achieved.

Sir Leonard Hill has collected a certain amount of gossip about radium and narrates a few cases of failure due to the misuse of radium which have come to his personal notice. To counterbalance his citation of deplorable failure, I could quote instances in my own experience where men with cancer of the throat, and elsewhere, have been treated by radium and returned in full health and happiness to their useful work and daily life.

It is admitted by all that the cause, prevention and cure of cancer have not yet been attained. In some cases, when early treatment has been given, there has been cure or palliation by three chief means, surgery, radium, X-rays. All three methods can be and have been grossly abused in some cases, but wisely applied in a vast number of instances. It is not proposed to abolish railway signals because a signalman has wrecked a train by pulling the wrong switch; the effort is made to improve the arrangement, to make it fool-proof, to have an efficient block system. Surgery is not condemned wholesale because of occasional deaths by incapacity, ignorance or carelessness. There have been deaths from dressings or swabs left in the wound. The wrong gas has been administered as anæsthetic. Overdoses of morphia have been given. A man can cut his throat with a safety razor. All such mistakes are no justification for complete disuse of the means employed.

It is, however, necessary to answer Sir Leonard Hill's ill-timed statement in a more positive sense, always remembering that while surgery has been under the guidance of men of high skill and intelligence for centuries—of men provided with every facility—on the other hand, both radium and X-rays are recent discoveries and naturally their applications to therapy are yet in their infancy.

A system of properly controlled and measured dosage, which can be repeated at will with exactitude, has scarcely yet been fully evolved. Certainly, in the past haphazard applications have produced deplorable results, but these are now avoidable in consequence of the research work already done on the proper direction of the radiation and on the determination of the magnitude of the dosage delivered to the growth and to the surrounding tissues.

Sir Leonard raises the question of the relative merits of radium and of X-rays and settles the matter to his own satisfaction with a positive assertion in favour of X-rays. In no part of the world has this difficult question yet been answered with sufficient scientific evidence to admit of certainty. The same uncertainty prevails as to the rival merits of X-rays of various voltages and wave-lengths. We may conjecture, but we cannot assert. Indeed these two important questions are forming part of an investigation by the Radium Beam Therapy Research under the Medical Research Council, and it is a matter for deep regret that this important work should be temporarily suspended by the exigencies of war.

Some of my well-informed friends point out to me that, in the case of cancer of the uterus, Wertheim's operation for the removal of the whole organ has been given up by surgeons throughout the world and replaced by the use of radium and subsequent wider irradiation with X-rays. This change was largely due to the influence of pioneer work done at the Curie Institute in Paris and Radiumhemmet of Stockholm. In fact, no sooner was the radium placed underground in September than gynæcologists implored that some of it should be made immediately available to save life and relieve distress.

In the case of cancer of the breast, both surgery and radiation are available, and it is a matter of expert advice to decide which is the better in a given case; always insisting on the importance of early and *correct* diagnosis. In carcinoma of the throat, treatment by the radium beam can be used without mutilation or loss of speech, and in cases too advanced for surgery. While surgery may be of some avail with cancer of the rectum and prostate, we have to admit with regret that all methods fail when the œsophagus or stomach is concerned. In less serious cases—such as skin and lip cancer—either surgery or radiation is effective, but most patients would prefer to avoid mutilation and scar by the simple and perfectly safe application of a few milligrams of radium, or its equivalent, for a few hours.

It is scarcely necessary to reply to Sir Leonard Hill's reference to those unfortunate girls, who licking radium paint from their brushes, accumulated radium in their system. Is it suggested that this is in the remotest degree connected with radium therapy? As to the miners' phthisis in the Joachimthal mines, it can unfortunately be matched with closely similar results in the gold mines of South Africa—a matter requiring the closest attention and medical research with a view to prevention and cure.

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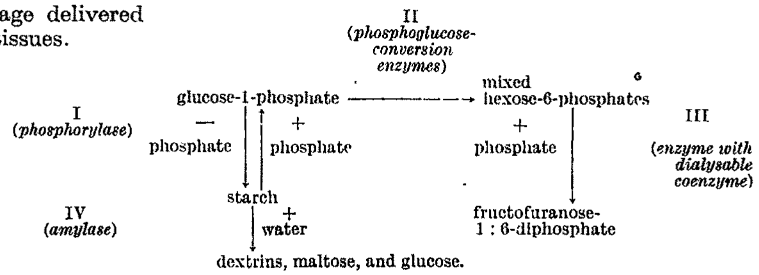
Feb. 5.

Enzymic Synthesis of Starch from Glucose-1-Phosphate

IN an earlier investigation[1] it was shown that pea seeds contain a complex of enzymes which catalyse the following series of reactions, I–IV:


II
(phosphoglucose-conversion enzymes)
glucose-1-phosphate
mixed hexose-6-phosphates
I
(phosphorylase)
— phosphate
+ phosphate
+ phosphate
III
(enzyme with dialysable coenzyme)
starch
IV
(amylase)
+ water
fructofuranose-1 : 6-diphosphate
dextrins, maltose, and glucose.

These transformations exhibit a striking parallelism with those associated with the breakdown of glycogen, and its recently reported synthesis from glucose-1-phosphate (Cori-ester), under the action of the enzymes of yeast[2], muscle[3] and liver[4].

In order to study in isolation the reversible reaction I it was necessary to obtain the phosphorylase free from the enzymes which catalyse the alternative reactions II and IV. This was achieved with extracts from pea meal by a process of fractional precipitation with ammonium sulphate.

Meanwhile it has been found that many plants contain phosphorylase, which is present in various organs including leaves, roots and tubers. The potato tuber has proved to be a particularly suitable source. Crude juice pressed from this tissue contains an active phosphorylase but exhibits no phosphoglucose-conversion activity; the weak amylase which is present is completely eliminated, and the phosphorylase is purified, by repeated fractional precipitation with ammonium sulphate.

Using these purified preparations of potato phosphorylase, a detailed study has been made of the reaction:

$$\text{Starch} + \textit{free}\text{-phosphate} \underset{b}{\overset{a}{\rightleftharpoons}} \text{glucose-1-phosphate.}$$

A state of equilibrium is reached, whether the reaction is proceeding in directions *a* or *b*, when the ratio of *free*-phosphate to glucose-1-phosphate attains a value which varies with the concentration of hydrogen ions. Thus in the equilibrium state at pH 6·4, 83 per cent of the phosphate exists as free-phosphate and 17 per cent as glucose-1-phosphate, whereas at pH 5·4 the proportions are about 90 per cent and 10 per cent respectively.

The equilibrium is not measurably affected by additions of starch even in considerable amounts, suggesting that the *effective* concentration of this reactant is not proportional to its *gross* concentration.

The presence of added starch, however, has a striking effect upon the velocity of the reaction proceeding in direction *b*. Without added starch there is a pronounced induction phase (in both the synthesis of starch and the liberation of *free*-phosphate). The initial velocity is increased by as much as 15-fold, and the induction phase completely abolished, by small additions of starch. This was the case in digests 1 and 2 (shown in Fig. 1), to which 2 mgm. soluble starch per 10 ml. was added initially. Other substances have been found to exert a similar activating effect upon the reaction, maltose being an example which has been investigated in detail. This phenomenon, which promises to illuminate the mechanism of the catalysis, will be considered fully elsewhere.

Several specimens of synthetic starch, about 20 gm. in all, have now been prepared from glucose-1-phosphate (purified by recrystallization of the potassium salt). The yields of polysaccharide corresponded closely in all cases with those calculated from the amounts of phosphate liberated, and amounted under appropriate conditions to twenty times the weight of dry matter in the enzyme. The principal difficulty in the purification of the synthetic starch has been the removal of protein; thus the precipitates formed on adding trichloroacetic acid or lead acetate contained the bulk of the starch; conversely, the blue-black flocculum formed by the addition of iodine contained much of the protein of the enzyme solution. The reason for this became clear when it was found by microscopic examination that, in advanced stages of the reaction when a marked turbulence develops, the starch is present in the form of small rounded granules which appear to be surrounded by loose floccules of protein; the starch grains are clearly visible whether or not they are stained with iodine (Fig. 2). Under the conditions so far used they attained a maximum diameter of 6–8 µ.

Various observations indicate that the synthetic polysaccharide is closely similar to natural starch. The main discernible difference lies in physical properties, the synthetic material being more resistant to solution and tending to retrograde more rapidly than natural starch of the common relatively large-grained varieties. The following are some of the analytical observations made on purified specimens:

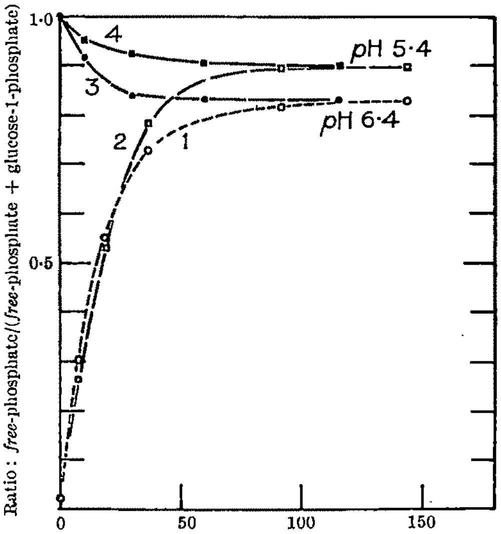


Fig. 1.

CURVES 1 AND 2 SHOW THE PROGRESS OF THE REACTION: GLUCOSE-1-PHOSPHATE → *free*-PHOSPHATE + STARCH, CATALYSED BY PURIFIED POTATO PHOSPHORYLASE; FINAL *p*H VALUES, 6·4 AND 5·4, RESPECTIVELY. CURVES 3 AND 4, AT THE SAME RESPECTIVE *p*H VALUES, SHOW THE REVERSE REACTION. IN DIGESTS 1 AND 2, APPROXIMATELY, *M*/100 GLUCOSE-1-PHOSPHATE WAS ADDED INITIALLY TO THE ENZYME, WHEREAS IN DIGESTS 3 and 4 STARCH WITH *M*/100 INORGANIC PHOSPHATE WAS ADDED.

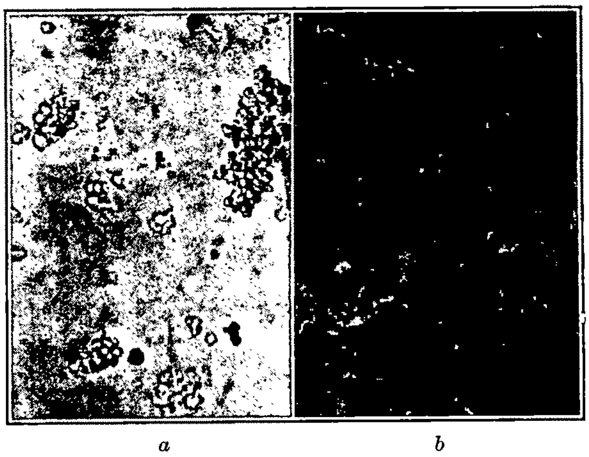


Fig. 2.

PHOTOGRAPHS SHOWING THE GRAIN STRUCTURE OF THE SYNTHETIC STARCH. *a*, UNSTAINED; *b*, WITH DILUTE IODINE. (× 290.)

Rotation—$[\alpha]_D^{20}$ + 200–206° (in water); + 152–159° (in 5 per cent soda); *Reducing power* (by copper reagent)—before hydrolysis, less than 1 per cent the reducing power of glucose; after 2·5 hours in *N*. hydrochloric acid at 100°—equivalent to 99 per cent conversion into glucose; nitrogen—0·05–0·5 per cent; phosphorus—0·05 per cent. In solution it gives a blue colour with iodine with the formation of typical iodine-starch floccules. The iodine-colouring property is rapidly destroyed by the action of the α-malt or salivary amylases.

The full discussion of the above interconversion, in which glucosidic linkages are formed and cleaved with the elimination and addition, respectively, of phosphate will be undertaken elsewhere.

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Jan. 30.

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[1] Hanes, *Proc. Roy. Soc.*, B (in the press).

[2] Schäffner and Specht, *Naturwiss.*, **26**, 494 (1939); Kiessling, *Naturwiss.*, **27**, 129 (1939).

[3] Cori, Schmidt and Cori, *Science*, **89**, 464 (1939).

[4] Cori, Cori and Schmidt, *J. Biol. Chem.*, **129**, 629 (1939); Ostern, Herbert and Holmes, *Biochem. J.*, **33**, 1858 (1939).

The Nerve of the Pineal Gland

A BUNDLE of nerve-fibres running upwards from the tip of the pineal gland in some mammals was described by Kolmer and Loewy in 1922[1], and was termed by them the "nervus conarii". However, the existence of this nerve as a constant feature has not hitherto been generally recognized, and its origin and destination remain obscure. It has been described by Pastori[2] as having a terminal relation to the wall of the great vein of Galen (vena magna cerebri). Recently the nerve has been identified and studied in this laboratory in monkey and human material. In both cases it has been traced, in cleared preparations and in serial sections, following an uninterrupted course from the pineal gland along the vein of Galen to enter the dural wall of the straight venous sinus, where it runs in a subendothelial position.

In the human brain, the nerve passes through a remarkable formation of the arachnoid membrane. This resembles in some degree a greatly enlarged arachnoid granulation (Pacchionian body), measuring, in one specimen, 4·0 mm. in height and 2·5 mm. in width at its base. It projects up from the surface of the adjacent part of the cerebellum into the floor of the straight sinus at the point where this is joined by the vein of Galen, and is here attached to the dura mater. The structure of the granulation is peculiar in that it is filled with a sinusoidal plexus of blood-vessels and several large inter-connecting blood-sinuses. The pial matrix is unusually dense, and the general appearance bears a close resemblance to erectile tissue. The real nature and function of this arachnoid formation are still uncertain, but its structure and disposition suggest strongly that it may play an important part in regulating the venous return from the ventricles of the forebrain through the vein of Galen. In a distended condition, the granulation would bulge up conspicuously into the floor of the straight sinus at its anterior end, in a manner which must presumably impede the venous flow.

The nervus conarii, in traversing the granulation, actually passes through the cavity of one of the blood sinuses, ensheathed here in a fine covering of pial tissue. It then runs directly from the summit of the granulation into the dura mater and, as already noted, turns backwards in the floor of the straight sinus. Its further course has not yet been followed. The direction of conduction in the nerve is not known ; the fact that in the monkey it can be traced to a core of neuropil in the centre of the pineal gland, in which are embedded numerous large ganglion cells of an autonomic type, suggests that it may be efferent with regard to the gland. On the other hand, most authorities are now agreed that true nerve cells are not a normal constituent of the human pineal gland. The nerve is accompanied by a small arteriole, but this vessel is considerably smaller than the nerve itself. Finally, it may be noted that neither the monkey nor the human material has provided confirmation for the existence of a ganglion at the tip of the pineal gland, as described by Pastori.

A detailed report of these observations will shortly be published.

W. E. LE GROS CLARK.

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Feb. 11.

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[1] Kolmer, W., and Loewy, R., *Pflügers Arch.*, **196**, 1 (1922).

[2] Pastori, G., *Zeitschr. d. ges. Neur. u. Psych.*, **117**, 202 (1928).

Cannabidiol and Cannabol, Constituents of *Cannabis indica* Resin

IN a previous publication, Work, Bergel and Todd[1] described a method for the separation of cannabinol from *Cannabis indica* resin (hashish) of Indian origin as its crystalline *p*-nitrobenzoate. In the course of further work on hashish we have been able, through the co-operation of the Home Office (Drugs Branch), to examine a fresh specimen of the Egyptian drug. Application of the *p*-nitrobenzoylation process to the distilled resin from this material yielded a less soluble fraction consisting of cannabinol *p*-nitrobenzoate (in smaller amount than from the Indian drug) mixed with a second ester of much lower melting point. The latter was very difficult to separate and purify ; the free phenol obtained from it by hydrolysis was a yellowish resin which, in contradistinction to cannabinol, gave a positive Beam test (purple colour with alcoholic potassium hydroxide).

Adams, Hunt, and Clark[2] have recently described the isolation from American hemp resin of a substance, cannabidiol, yielding a *bis*-3 : 5-dinitrobenzoate, m.p. 106–107° ($[\alpha]_D^{27°} = -76°$). The similarity in colour reactions of cannabidiol and the above substance from the Egyptian resin was immediately evident, and conversion of the latter to its *bis*-3 : 5-dinitrobenzoate gave an ester m.p. 106–107° of which the analysis and optical rotation ($[\alpha]_D^{13°} = -76 \cdot 2°$) also agreed with those of the cannabidiol derivative ; there can be little doubt as to the identity of the two compounds. The molecular formulæ of cannabinol $C_{21}H_{26}O_2$ and cannabidiol $C_{21}H_{30-32}O_2$, together with their simultaneous occurrence in hemp resin, suggest a structural relationship between the two compounds, and preliminary chemical investigation seems to bear this out[2]. It would seem that, as regards these constituents, Egyptian hemp resin occupies a position intermediate between American resin, in which cannabinol seems absent, and Indian resin, from which cannabidiol has not yet been isolated, although it may be present in small amount.

The physiological inactivity of cannabidiol lends further colour to the view that the Beam test is not a specific test for the active principle in hashish. We have noticed for some time that our most active fractions (Gayer test[3]) from the Indian drug give no coloration with alkali.

From certain fractions of Indian hashish we have recently, by acylation with azobenzene-4-carboxylic acid chloride, obtained a crystalline ester, m.p. 117–118° (Found : C, 78·0 ; H, 7·5 ; N, 6·1. $C_{21}H_{31}O.OCOC_{12}H_9N_2$ requires C, 77·9 ; H, 7·6 ; N, 5·4), apparently derived from a monohydric phenol. Alkaline hydrolysis of this ester gives a resinous phenol which reacts negative in the Beam test and gives, like cannabinol and cannabidiol, a positive indophenol reaction. The constitution of this new substance, which we name *cannabol*, remains to be elucidated, but it seems probable that it is a partially hydrogenated cannabinol isomeric with cannabidiol. This would accord with a possible view of the biogenesis of these substances. Cannabidiol may arise by condensation of a terpene with a dihydric phenol ; cyclization would then yield cannabol, from which cannabinol could be obtained by dehydrogenation.

Further details of this work will be published elsewhere.

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Feb. 6.

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Polyploidy in *Rumex acetosella* L.

The species *Rumex acetosella* L. is a weed, which seems to be distributed all over the northern hemisphere. It has been investigated cytologically by Roth[1], who counted the chromosome number $n = 16$ ($2n = 32$), and later, among others, by Meurman[2], Kihara[3], and Jensen[4], who all found the number to be hexaploid or $2n = 42$.

Last summer I examined material of *Rumex acetosella* and its varieties from Sweden and Iceland. In the main species, having rather broad leaves, I also found the hexaploid number $2n = 42$, both in the male and the female individuals. However, in plants belonging to the variety *tenuifolius* A. and Gr. (Ascherson and Graebner[5]), the number proved to be $2n = 28$, or tetraploid. This number was not known before in *Rumex acetosella*, according to Tischler[6].

The leaves of the tetraploids are narrower than those of the hexaploid forms. In other details the tetraploid variety is also smaller than the main type, and most often shows a prostrate mode of growth. Both the tetraploids and hexaploids are quite normal sexually, and they also seem to have different geographical distribution.

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Occurrence of Bismuthinite in Somerset

At the end of July last year, while examining the material on the waste-heaps of the Langham Hill Mine, one of the group on the Brendon Hills, Somerset, which was worked for iron during the middle and latter half of last century, I noticed small stains and patches of malachite on some of the crystalline chalybite at one end of the main dump. A number of these pieces were collected and, on being broken open, were found to contain small amounts of chalcopyrite, bornite, and occasionally chalcocite, while a few had, in addition, thin veins and patches of a steel-grey metallic mineral scattered through them, in some cases closely intergrown with the copper minerals.

Blowpipe tests on this steel-grey material showed the presence of copper and bismuth, and from its association with the other copper compounds, it was at first taken as possibly being tetrahedrite; recent chemical and X-ray examination, however, by Mr. F. A. Bannister, of the Mineral Department of the British Museum (Natural History), has proved it to be bismuthinite (Bi_2S_3).

The presence of small amounts of copper minerals at one or two of these mines has been previously noted and mentioned, but there is no record of bismuthinite being found on the Brendons before, and it is a somewhat unexpected mineral to come across in this particular district, or, in fact, in Somerset as a whole.

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Points from Foregoing Letters

S. Russ comments on recent statements by Sir Leonard Hill on the present-day position of radium treatment. He affirms it is not true that this form of treatment is largely carried on because of the vested interests of medical men; the reason for 15,000 patients having been treated in 1938 is that it was considered by responsible medical opinion to be the best treatment available for them.

A. S. Eve also discusses Sir Leonard Hill's communication. He states that in cases of cancer of the uterus radium is frequently preferred to surgery. Inoperable cases of cancer of the throat are improved by radium beam treatment. The relative merits of radium and X-rays require further investigation, and the same is true of X-rays of various wave-lengths. Great Britain requires a radiological institute for the development and investigation of radiation treatment. In the meantime surgery, radium, X-rays all have their spheres of usefulness which overlap one another.

C. S. Hanes reports the occurrence in various higher plants of an enzyme which catalyses the reversible conversion of starch into glucose-1-phosphate. The effect of different factors upon the equilibrium is discussed, together with observations on the properties of specimens of starch synthesized from pure glucose-1-phosphate by the action of this enzyme. A fact of considerable botanical interest is that the synthetic starch is deposited in the form of well-formed grains.

W. E. Le Gros Clark states that the nerve of the pineal gland (nervus conarii) has been identified in human and monkey material. It runs an uninterrupted course from the tip of the pineal gland into the dura mater of the tentorium cerebelli, and then extends backwards in the floor of the straight venous sinus. On its way the nerve traverses a large arachnoid granulation the structure of which is peculiar in that it contains a plexus of sinusoidal blood-vessels. From the position of this granulation it is surmised that it may play an important part in regulating the venous return from the brain through the great vein of Galen.

The isolation of cannabidiol from Egyptian hashish is reported by A. Jacob and A. R. Todd, who find that in respect of its content of this substance and cannabinol the Egyptian drug is intermediate between the American and Indian varieties. A new compound *cannabol*, which is probably a partially hydrogenated cannabinol, has been obtained from Indian hashish.

RESEARCH ITEMS

Bronzes from Southern Nigeria

A REMARKABLE collection of bronze castings found at Igbo, Southern Nigeria, is figured and described by J. O. Field, assistant district officer, in *Man* of January 1940. They were unearthed in the course of digging a well, but no details are available. The castings would seem to have been made by the *cire perdue* process, though rubber latex may have been used instead of wax. The castings are covered with a rich green patina. The finest piece is an urn or cauldron 10½ inches high with a diameter across the top of 8 inches. It forms a shallow bowl with broad lip on a wide hollow stand. It is decorated with a series of rosettes interspaced with beetles and grasshoppers. At top and base are bands of hatched triangles and in the middle a broad band with a complicated design of rectilinear figures and circles. The edge of the lip and the base are decorated with a twisted cord design. Among other objects are two scabbards in which are the remains of iron blades, but without hilts, a bust with evidence of bead ornament, small shells which rotate, a human head, possibly female, showing cicatrization resembling the modern style, two highly conventionalized rams' heads, with highly ornate twisted horns and three spiral objects, of which two display a snake *motif*, while another peculiar object is a massive casting elaborately ornamented with eyelets, loops and whorls, and also extensively ornamented with coloured beads, and near the top a series of rings from which emerge small snakes' heads, having above them a wheel-like flange with a great number of triangular spokes and on top of this a wide metal ring. The occurrence of an 'Aro knot' suggests contact with the Aro people, but the earliest tradition of their presence in the region does not go back beyond about the middle of the last century. Otherwise there is nothing to determine the origin of this metal work. The Igbo people are not themselves metal workers, and it is improbable that they were made by Benin craftsmen.

Canoe-making in Ancient Hawaii

A TREATISE on the canoe-making profession of ancient times, of native authorship but undated, found among the archives of the Bernice P. Bishop Museum, Honolulu, has been translated and edited by Kenneth P. Emory and Mary Pukui (*Occasional Papers, Bernice P. Bishop Mus.*, 15; 1939). The writer opens with the statement that the profession was much practised in Hawaii to provide the canoes for fishing, for war and for voyaging from island to island, the experts who built them being much honoured and favourites of the chiefs. There were classes of experts under the classes of royal builders, such as the experts of the supreme ruler, of the ruling chiefs, of the district chiefs, and so forth. Of the timbers used, the koa (*Acacia koa*) was the best. All the forests were occupied by experts for making canoes. The adzes used were of stone. Their making was a laborious task, in which the various operations, chipping, grinding, lashing, were each done by different specialists. Different adzes were used for the various operations—chopping, hewing, hollowing. The canoe-makers were supplied with ancestral gods, who helped in the hewing and hauling. They were both male and female. The canoe-makers were also provided with offerings. If the canoe belonged to a chief these offerings were a hog, red fish, clothing, coconuts and awa. The hog was cooked at the place where the koa tree was to be found. The ancestral gods partook after an invocation, and then all the priests present partook of their portion. The cutting of the tree then began, the priests cutting in pairs. A little bird signified whether the tree would be good or the reverse. The canoe of a chief was hauled to the shore by the people after a feast. Felling the path of the canoe was the last thing to be done. If a new canoe was first taken on a fishing trip, the first fish caught was brought back and offered to the ancestral gods.

Birds of Newfoundland and Colour Modification

SURPRISINGLY little is known of the birds of eastern Newfoundland, and accordingly brief explorations made by David C. Nutt while a member of the Robert A. Bartlett Greenland Expeditions of 1937, 1938 and 1939, have added considerably to the knowledge of distribution, abundance and geographic variation. The results, by John W. Aldrich and David C. Nutt, have recently been published (*Sci. Pub. Cleveland Museum Nat. Hist.*, 4, 13; 1939). From a general point of view, the most striking result is the discovery that where geographic variation has taken place among resident birds it is shown in a marked darkening of the plumage. This was found, for example, in birds so different as a creeper, *Certhia familiaris*, robin, *Turdus migratorius nigrideus*, "the most deeply coloured of all the American robins", warbler, *Dendroica breviunguis*, water-thrush, *Seiurus n. noveboracensis*, crossbill, *Loxia l. leucoptera*, and others. A similar darkness of plumage was noted in 1919 by G. K. Noble in birds from the western part of the island, but in the east the deepening of colour is even more marked, and confirms Noble's opinion that Newfoundland is a region where the differentiation of dark coloured races is beginning to take place. It may be associated, as is probably also the case in the outer islands of Scotland, with the exceptional humidity of the region.

Transpiration into a Saturated Atmosphere

H. H. Dixon and J. S. Barlee have recently published a paper describing further experiments on transpiration into a saturated atmosphere (*Sci. Proc. Roy. Dub. Soc.*, 22, No. 20, 211; Feb. 1940). A potometer method for comparing the rates of transpiration in gases supersaturated with water is described, and it is shown that replacement of air with nitrogen around the leaves depresses and ultimately inhibits the upward movement of water in a stem. Renewal of the air restores transpiration. Anæsthetization with chloroform reduces or stops the movement; and at least temporary recovery may be attained by surrounding the leaves with supersaturated air. If the supply of supersaturated nitrogen or chloroform is prolonged, reversal of the upward current is produced, and the shoot behaves like a dead system and the water condensing on the leaves flows downwards in the stem.

Inheritance of Inability to Sweat

L. C. Glass and Darrell H. Yost (*J. Hered.*, **30**, 477–478 ; 1940) report the inheritance of the inability to sweat. The affected individuals show distress at above 85° F., are subject to severe headaches and stomach trouble. The pedigrees suggest that the character is either inherited as a monogenic recessive or on a multiple factor basis. Not only is there an absence of sweat glands in the skin, but also other anomalies of skin development are present.

Sweet Potato Breeding

The sweet potato rarely flowers or sets seed under field conditions in Louisiana. J. C. Miller (*J. Hered.*, **30**, 485–492 ; 1940) reports useful methods for the induction of flowers and seed under these conditions. By staking the plants, three varieties were induced to flower, while girdling trebled the number of flowers and also induced earlier flowering. Seed setting was considerably increased by keeping a flowering branch in a water solution of artificial fertilizers in a house.

Cytological Investigations in Allium

S. W. Mensinkai reports on the chromosomes of seventeen species of Allium, fifteen of which had not been previously reported. *A. sativum*, and *A. Cepa* ($2n = 16$) are taken to be secondarily balanced diploids since they possess two pairs of nucleolar chromosomes and two pairs of nucleoli. Univalents were observed at meiosis in *A. Cepa*, *A. Sewerzowii*, *A. nigrum*, *A. scorzoneræfolium* (all diploids) and *A Bidwelliæ* (tetraploid). The individuals examined of *A. Cepa*, *A. Sewerzowii*, *A. cilicum*, *A. scorzoneræfolium*, *A. nigrum* and *A. Bidwelliæ* were inversion heterozygotes.

Wound Hormones of Plants

Many plant tissue extracts are capable of inducing renewed growth activity in mature plant cells. These growth-inducing extracts are usually obtained from ground or heated tissues and are capable of evoking cell division and cell enlargement in unwounded cells. The active principles have been referred to as wound hormones by Haberlandt. J. English, J. Bonner and A. J. Haagen-Smit (*J. Amer. Chem. Soc.*, **61**, 3434 ; 1939) find that the crystalline substance isolated from string bean pods and capable of inducing renewed cell division and cell extension activity in the parenchymatous cells of the bean pod is 1-decene-1,10-dicarboxylic acid (which they propose to call 'traumatic acid'), which was also synthesized. This is capable of inducing wound periderm formation in washed disks of potato tuber and to function thus as a wound hormone. Traumatic acid is also capable of partially replacing the juice of the tomato fruit in reversibly inhibiting the germination of tomato seeds.

Synthesis of Vitamin K_1

L. F. Fieser (*J. Amer. Chem. Soc.*, **61**, 3467 ; 1939) has found that synthetic 2-methyl-3-phytyl-1,4-naphthoquinone is identical with natural vitamin K_1 by a direct comparison of samples with regard to analysis, spectrum, anti-hæmorrhagic activity, colour reaction, and the melting point and mixed melting point of a crystalline derivative. This confirms the conclusion reached by Doisy and co-workers from degradative experiments (*ibid.*, **61**, 2558 ; 1939) and from a further synthesis (*J. Biol. Chem.*, **130**, 433 ; 1939), published after the present work was completed. The synthesis was essentially a one-step process utilizing 2-methyl-1,4-naphthohydroquinone and phytol, and provides a method of preparing the vitamin in quantity. By separating and purifying the product in the reduced form prior to oxidation, the quinone is obtained in a pure condition without recourse to distillation or adsorption. Natural vitamin K_1 can be isolated very easily from alfalfa concentrates by a similar procedure. Vitamin K_1 yields phthiocol on cleavage with alcoholic alkali.

Oxidation with Lead Tetra-acetate

It is known that the cleavage of the carbon chain in compounds containing two and three adjacent hydroxyl groups can be carried out with lead tetra-acetate in aqueous as well as in non-aqueous solution. J. M. Grosheintz (*J. Amer. Chem. Soc.*, **61**, 3379 ; 1939) finds that the cleavage of the carbon chain of a number of glycosides with lead tetra-acetate is parallel to that known to be produced with periodic acid. The oxidative changes of alpha- and beta-methyl-*l*-arabinopyranosides can be carried out quantitatively in aqueous solution. Contrary to previous experience, three molecules of lead tetra-acetate instead of two were required to complete this reaction, and the reason was found to be the oxidation to carbon dioxide of one molecule of formic acid formed during the first reaction. This reaction does not occur in dry organic solvents or in oxidation in aqueous solution by means of periodic acid, and the formic acid may be oxidized in its ortho-form.

Photometry of the Solar *D* Lines

Although the *D* lines have been measured several times previously, there has always been some doubt about the instrumental corrections, more especially for the central intensity. In a recent paper (*Mon. Not. Roy. Astro. Soc.*, **100**, 1 ; November 1939), C. W. Allen gives the results of his measurements, corrections derived from a comparison with terrestrial water-vapour lines having been used. The sun telescope and three-prism spectrograph of the Commonwealth Solar Observatory were utilized for the solar spectra of the *D* region. Plates were taken of both centre and limb of the sun near midday, and others were exposed for a few minutes after sunrise to ensure strong water-vapour lines. The results for the central intensities and equivalent breadths are in good agreement with his observations made some five years ago, but the central intensities are much smaller than Houtgast's results published in 1938. The discrepancies are due to the fact that Houtgast made no corrections for finite resolving power.

An Altazimuth Mounting for Reflecting Telescopes

The Rev. W. Rees Wright has described a useful wooden mounting to carry a 9-inch reflector which he has manufactured himself (*J. Brit. Astro. Assoc.*, **50**, 3 ; 1940). The base of the stand is merely a stout three-legged stool, each leg being 30 in. long and 3 in. by 2 in. in section. The top consists of two thicknesses of 1-in. wood, screwed together with the grain crossing, and twelve ball-casters are screwed to the upper piece so as to form a circular bearing for the head. It is possible to raise or lower these casters slightly to make certain that all bear on the head in all positions. Many other details are given which can be easily followed by amateurs, who are recommended to study the description with the diagram if they require a cheap and efficient mounting for a small reflector.

FLORAL ANATOMY OF THE OLEACEÆ

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A STUDY of the floral anatomy of the Oleaceæ, including *Jasminum pubescens*, *J. Sambac*, *J. auriculatum*, *J. arborescens*, *J. grandiflorum*, *J. humile*, *Nyctanthes arbortristis*, *Olea cuspidata*, *O. fragrans*, *Syringa vulgaris*, *S. emodi* and Ligustrum spp., has brought to light many interesting facts, particularly with regard to the anatomy of the pedicel in Jasminum species and the vascular supply of the ovule. As the full work will take still some time to be completed, the more important observations made so far are recorded here.

The pedicel has normal structure in Olea, Syringa and Ligustrum. Even in *Nyctanthes arbortristis*, where the vegetative stem is characterized by the presence of four inversely orientated cortical bundles[1], the cortical bundles gradually disappear in the floral axis and it has a normal structure. In Jasminum species, however, the condition is very different. In *J. auriculatum*, *J. humile* and *J. arborescens*, the pedicel has normal structure, but in others the pedicel shows, besides the normal vascular ring, many additional bundles in the pith, even though the structure of the vegetative stem is quite normal. Thus in *J. pubescens*, we find that the pedicel just at its base shows only one ring of vascular bundles, but as we proceed upwards, two or three bundles of phloem make their appearance in the pith. Higher up, the number of such bundles increases and they develop both xylem and phloem, so that a transverse section of the pedicel shows many medullary bundles irregularly scattered inside the normal ring (Fig. 1). The structure of these bundles is very variable. They may be collateral, normally or inversely orientated, bicollateral, concentric with phloem in the centre, or may consist of phloem alone. As the calyx-traces begin to pass out, we often find the medullary bundles to show a more regular arrangement. They tend to form a ring of mostly inversely orientated collateral bundles to the inside of the normal ring (Fig. 2). This condition resembles to a certain extent the structure of the stem in certain species of Rumex belonging to the section Lapathum[2], or the structure of the stem of many Cucurbitaceæ[3] and other families possessing medullary phloem. At a still higher level in the thalamus of *Jasminum pubescens*, the medullary bundles gradually pass out and disappear, merging into the bundles of the normal ring. In a large-flowered variety, however, it was observed that all the medullary bundles ultimately fuse in the centre and give rise to a prominent concentric bundle in the centre of the thalamus stele (Fig. 3), which divides again into about four branches that fuse with the ventral traces of the carpels. The pedicel in *J. grandiflorum* shows structure very similar to that of *J. pubescens*, but the medullary bundles are still better

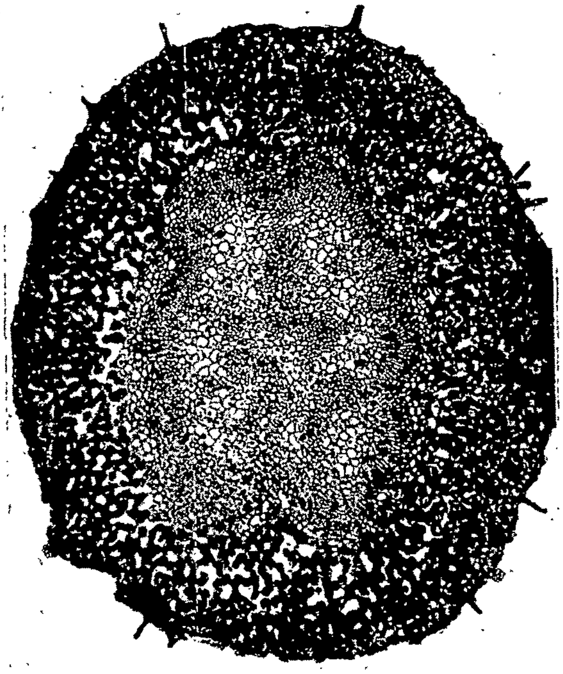

Fig. 1.

Jasminum pubescens. TRANSVERSE SECTION OF THE PEDICEL SHOWING IRREGULARLY SCATTERED MEDULLARY BUNDLES.

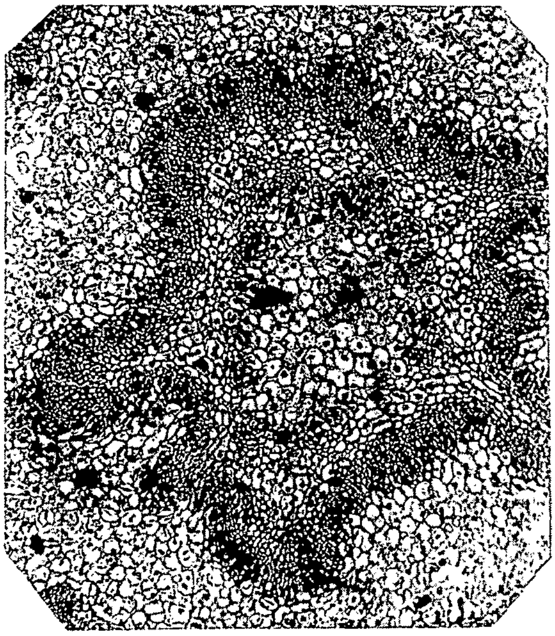

Fig. 2.

Jasminum pubescens. TRANSVERSE SECTION OF THE THALAMUS ABOUT THE LEVEL OF THE ORIGIN OF THE CALYX-TRACES SHOWING A REGULAR RING OF MEDULLARY BUNDLES INSIDE THE NORMAL RING.

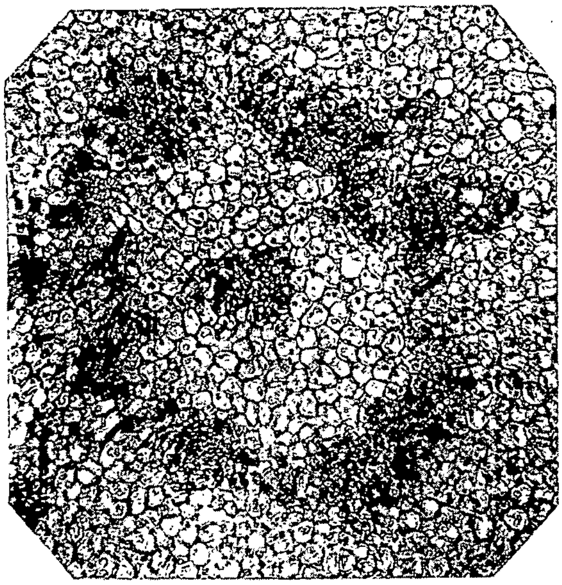

Fig. 3.

Jasminum pubescens, LARGE-FLOWERED VARIETY. TRANSVERSE SECTION OF THE THALAMUS JUST BELOW THE OVARY SHOWING A CONCENTRIC MEDULLARY BUNDLE IN THE CENTRE OF THE NORMAL STELE.

developed. The pedicel in *J. Sambac* also shows medullary bundles, but here their number is comparatively smaller and they consist mostly of phloem alone (Fig. 4). Their structure, however, is essentially concentric, the phloem being surrounded by a cambial ring which forms new phloem elements towards the inside and occasionally some xylem towards the outside.

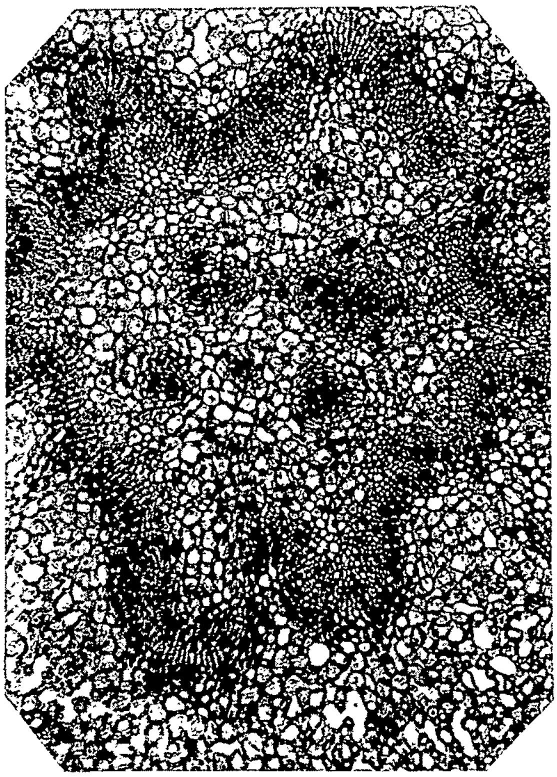

Fig. 4.

Jasminum Sambac. TRANSVERSE SECTION OF THE PEDICEL NEAR ITS DISTAL END SHOWING MEDULLARY BUNDLES OF PHLOEM SURROUNDED BY CAMBIUM.

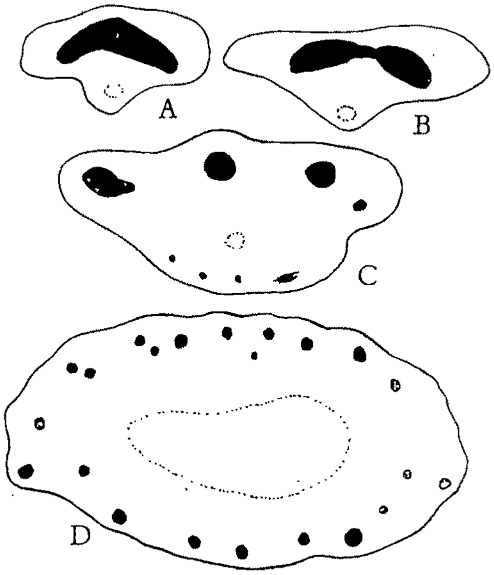

Fig. 5.

A–D. Nyctanthes arbortristis. TRANSVERSE SECTIONS OF AN OVULE FROM THE FUNICLE (*A*) TOWARDS THE MIDDLE (*D*).

The ovules of Syringa, Olea and Ligustrum species possess normal vascular supply. They receive a single bundle which runs up the raphe unbranched and ends in the chalaza. But in Jasminum and

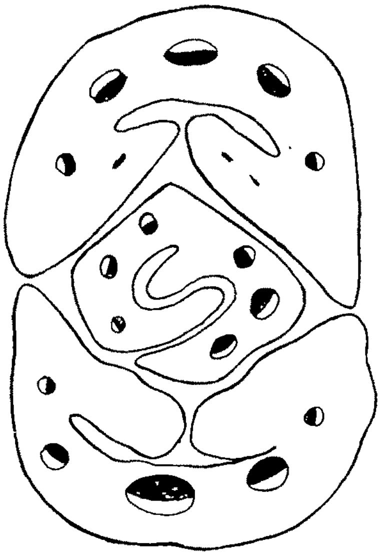

Fig. 6.

Olea fragrans. TRANSVERSE SECTION OF THE GYNŒCIUM SHOWING TWO DECUSSATE WHORLS OF OPEN CARPELS. THE OUTER CARPELS BEAR OVULES ALONG THEIR MARGIN. THE INNER CARPELS HAVE NOT YET COMPLETELY SEPARATED FROM ONE ANOTHER. AN OVULE IS SEEN ARISING FROM THE MARGIN OF ONE OF THEM.

Nyctanthes, the crescent-shaped ovular trace (Fig. 5*A*) soon after its entrance into the funicle divides into two bundles (Fig. 5 *B*). These bundles repeat the division and some of the branches pass to the opposite side (Fig. 5 *C*). These branches divide further, so that the ovule shows about its middle 25–30 bundles in the integument (Fig. 5 *D*). Such extensive development of the integumentary vascular system has been observed so far only in a few other flowering plants. These have been listed by Dahlgren[4]. From comparison with the gymnosperms, the presence of such an integumentary vascular system is generally regarded as a primitive character[5], but its occurrence in such gamopetalous forms as the Oleaceæ and the genus Echinops[4] of the Compositæ together with its absence from such a primitive order as the Magnoliales raises a doubt that this character may be really a recent acquisition related to the development of an exceptionally thick integument.

The perianth traces in the Oleaceæ are noteworthy for showing concentric structure, but specially interesting is the vascular supply of the calyx in *Olea fragrans*. In this species, although the calyx is quite well developed, in many flowers there are absolutely no traces for the four sepals. In other flowers, two or three weak sepal traces are given out, but these disappear in the thalamus itself and never reach the sepals. The calyx is thus quite non-vascular. This supports Mrs. Arber's[6] view that the vascular tissue is in no way more conservative than the organ it supplies.

The gynœcium of *Olea fragrans*, a cultivated garden shrub which does not set seed, consists of two whorls of opposite and decussate open carpels bearing ovules along their margins (Fig. 6). This abnormal structure of the gynœcium is the normal feature of this species in the material at our disposal.

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[2] Joshi, A. C., *Amer. J. Bot.*, **23** (1936).

[3] Holroyd, H., *Bot. Gaz.*, **78** (1924).

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RURAL LIFE IN EUROPE

By Dr. L. Dudley Stamp

It is one of the inevitable consequences of war that the steady march of social progress is interrupted by the more urgent problems of the moment. In Britain, for example, the great work of slum clearance and rehousing has been temporarily suspended, and it is actually possible in the lull to take stock of what has been achieved in the past twenty years. On the other hand, reforms which might have been delayed indefinitely may be rushed through if they have an important bearing on the prosecution of the War. The war-time ploughing programme of the Government may well be the salvation of British agriculture, and the evacuation to rural areas of both children and adults supplies just the stimulus which was needed to stem the tide of rural depopulation and the consequent disappearance of rural community life.

It is indeed certain that all the countries of Europe were becoming aware of the seriousness of the problems of rural life, and no fewer than twenty nations had agreed to take part in a European Conference on Rural Life—to be "devoted to the well-being and solidarity of the European peasantry"—under the auspices of the League of Nations at Geneva in October 1939. The Conference, a natural development of that on Rural Hygiene in 1931, was to have based its work on a series of documents previously prepared. The documents were of two main types: (*a*) illustrated national monographs, prepared officially according to a uniform plan, presenting in attractive style a résumé of the problems of rural life, and (*b*) studies on specific problems prepared by various international bodies.

Several of the national monographs were published[1]—including those for Belgium, Finland, Latvia, Lithuania and Netherlands—and form handy summaries covering the organization of rural life and occupations, including education, medico-social policy and nutrition.

Of the second group of pamphlets, the International Labour Office prepared one on recreation in rural areas and one on sickness and insurance; the International Institute of Intellectual Co-operation one on intellectual aspects of rural life, and the Health Committee of the League of Nations a general survey of medico-social policy. These surveys[2] suffer from the difficulty that they deal with political units so utterly different that comparisons are virtually impossible. The very word 'peasant' is rarely if ever applied to the English country dweller, and the problems here are obviously very different from those in eastern Europe. Nevertheless, it is remarkable that certain fundamental difficulties are apparent throughout—and outstanding is the inadequacy of rural housing. Cramped, overcrowded, ill-planned houses, frequently with antiquated sanitary arrangements, no piped water supply and lacking electric light not only affect health (for example, tuberculosis) but also prevent the proper use of leisure and opportunities for recreation and education which are otherwise available.

Rural housing is, after all, only one result of the fundamental economic position. A few years ago Lord Stamp[3] summed up the whole problem in a single sentence: "the world as a whole and over a given length of time has almost certainly been fed below cost-price for the last hundred years, if one takes into account the proper elements of costs". The more advanced nations are often the last to recognize that the rural countryside needs above everything money. Britain is certainly no exception; with the drift to the towns from the impoverished country areas Britain has become more and more urban-minded as well as urban-dwelling. The Town and Country Planning Acts only conceive 'planning' in terms of urban expansion, whilst slum-clearance is regarded as a problem of the great cities despite the fact that the worst slum is often the farm labourer's cottage.

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[1] Allen and Unwin, 40 Museum Street, London, W.C.1. 1*s*. 6*d*. each.

[2] Allen and Unwin, 9*d*. and 1*s*. each.

[3] "World Agriculture: an International Survey", 1932.

PRACTICAL ASPECTS OF EARTHING

IN a paper contributed by Messrs. E. Fawssett, H. W. Grimmett, G. F. Shotter, and H. G. Taylor, to the Institution of Electrical Engineers on February 14, a very thorough discussion is given of the practical aspects of earthing.

The practice of earthing is as old as that of electrical engineering; in fact it is older, as it dates back to the days when electricity was only a scientific study which scarcely interested the engineer. Earthing was then effected by touching the charged body with the finger, whereupon the charge leaked to earth. From then the practice has passed through many phases, though customs die hard, as shown by the 1937 report of electrical accidents in factories and workshops, which states that "another instance was found where the end of the earthed wire was put into a bucket of water, the bucket being specially purchased for the purpose and usually placed on a piece of wood 'to avoid leakage' ".

At the other extreme, and typifying the very latest practice, may be cited the proposal to install eight 32 ft. × ½ in. diameter copper rods at a Central Electricity Board substation to secure a resistance of less than one ohm, in soil having a resistivity near the surface of 15,000 ohm-cm. Before 1914 such a resistance would not have been obtained in such soil; in more recent times it might have been obtained, but at a cost at least several times greater than is required to-day; it is now a relatively simple matter. Earthing practice is a good example of the well-known fact that until a quantity can be measured and expressed numerically knowledge is restricted and improvement is slow. For this reason great credit is due to those firms which have produced simple forms of earth-testers which can be used as readily as an insulation-tester. By their use engineers have realized in some measure the limitations of methods of earthing which had been used for many years, they have realized the important effect of the resistivity of the soil, and finally they have found by a few tests that some methods of earthing are far more economical than others.

American engineers profited by a comprehensive publication on earthing issued by the Bureau of Standards in 1918. The recommendations of this report, which are still quoted, were well in advance of British practice at the time, though much has been done to make up the leeway during the last few years. Driven electrodes are now being widely used, and in two important fields, namely, voltage gradients on the ground surface around electrodes and current loading capacity of electrodes, the principal progress has been made in Britain. Research by the Electrical Research Association (E.R.A.) has also shown how the earth resistance of overhead-line towers may be measured without disconnecting the earth wire—a problem in measurement the solution of which is actually of greater importance in other countries than in Great Britain.

All the information necessary to design electrodes economically on a resistance basis is now available and is being used to an appreciable extent. All the research work also that is necessary that has been done on the problem of voltage gradient is available, though it is not as widely known as it should be. The loading capacity problem is still under examination; sufficient information is available to provide a lead in all soils and to give a good guide in clay; when this problem has been completely solved, it will be possible to design electrodes for any condition with as much precision as that of the electric appliances which they protect.

For several years past the E.R.A. has been carrying out investigations into the fundamental problems connected with earthing, and a number of reports have been published. It is considered that the present time is an appropriate one to review the work that has been done, with particular reference to the practical problems of supply undertakings. All the four authors have been closely associated with the E.R.A. researches; most of the work is now published for the first time.

It must be strongly emphasized that the value of the earth has an important bearing on the operation of high-voltage fuses and the protective gear installed. Earth leakage protection installed at the main points of an overhead ring main will ensure the safe operation of the switches by a high-resistance fault. If when the conductor falls the line is not cleared, such a fault may result in a serious accident.

Resistance earthing and so-called 'solid earthing' are general in Great Britain. Reactance earthing of the type practised in America is practically unknown, but tuned resistances (for example, Petersen coils) are now being installed to an appreciable extent. These coils are short-circuited occasionally, and consequently the earth resistance must be such as is required on an ordinary earth system.

In rural areas where the villages are far apart, and where each village is as a rule fed from one substation, the question of low-voltage neutral interconnexion does not occur, and it is here that the difficulty of earthing arises. On urban low-voltage systems it is generally easy to secure low resistances to earth, but in rural areas where water mains are frequently not available for earthing, there are serious difficulties. If it is proposed to work according to the regulations with just one earth, it is necessary to have the substation earth resistance very low (something less than five ohms), and this is frequently very difficult to secure.

In practically all instances in Great Britain where overhead lines have latticed steel towers for supports, these lines carry a continuous earth wire, the function of this wire being to ensure that all extraneous metal work is at earth potential, to act as a release for fault current, and as a protection against lightning. It has now been generally accepted that to make a line secure against lightning it is essential that the continuous earthed wire should be earthed at each tower and that this resistance should be less than about ten ohms. The foundations alone of these towers sometimes have a sufficiently low resistance for other protective purposes.

The earth resistance at consumers' premises should be sufficiently low to blow the largest fuses, but from the economical point of view this is not always possible. This has led undertakings to consider protective multiple earthing, neutralizing or earth-leakage circuit-breakers. The ordinary 18-in. square earth plate or the 3-ft. earth rod is of very little use in the majority of soils found in rural England. Ordinary earthing—that is, one system earth at the substation and the consumer's earth utilizing the public water mains or the cable sheaths—has proved quite satisfactory in urban areas and has been the general practice in Great Britain. The main difficulty with ordinary earthing occurs when the system is overhead and is situated in a district without a piped water supply. The use of strip electrodes has been the means of reducing substation earth resistances to a reasonable figure and deeply driven rod electrodes have also proved useful.

The chief disadvantage of protective multiple earthing is the danger arising from a broken neutral conductor. To minimize the risk the earth resistance of the neutral is made as low as possible, and earths are provided at all consumers' premises. Where the soil resistivity is high (as would generally be the case) this represents a serious expense. The money might be more advantageously expended in ensuring that in the event of only a neutral breaking it would make contact with a live wire and so blow the fuse and disconnect the supply from the faulty section.

In order to determine the reduction of resistance effected by salting, and the frequency with which it is necessary to re-salt electrodes, tests have been in progress over a period of five years in five different sites where various extremes of soil conditions and rainfall exist. Tables are given showing the seasonal change of resistance of electrolytes and the effect of salt and coke treatment. Whilst salting reduces the resistance of earth electrodes it is generally recognized that it increases the rate of corrosion. The following conclusions are of practical importance. Failure of all electrodes in clay soil is caused by the attainment of a temperature of 100° C. at the electrode surface. At this temperature the moisture present evaporates, and the resistivity of the soil increases to a very high value. In clay soil with alternating currents, small leakage currents flowing for a long time do not impair the characteristics of an electrode, since they reduce its resistance. On the other hand, they seriously impair an electrode's characteristics if the electrode is connected to a positive lead. New work is now planned on the behaviour of different types of soil, the requirements of Petersen coil earth electrodes, and the behaviour of long electrodes and electrodes in parallel.

FIRE FIGHTING EQUIPMENT FOR ELECTRICAL INSTALLATION

LAST year the Electricity Commission requested the Electrical Research Association (E.R.A.) to consider what steps should be taken to try to prevent a repetition of one or two disastrous fires that had taken place in connexion with electric power stations and electrical installation. The E.R.A. appointed a committee to consider the whole matter and its report was discussed at the Institution of Electrical Engineers in London on January 25.

Mr. H. W. Swann, H.M. senior electrical inspector for the Home Office, presented the report and opened the discussion. Mr. Swann pointed out that when his committee first took the matter in hand there was a dearth of information available as to the performance of certain media used for fighting fires, and, hearing that a good deal of work had been done in Paris on this subject, the committee paid a visit there and obtained a great deal of information. But it was felt that something more should be done in Great Britain. Luckily, the co-operation was obtained of the County of London Electric Supply Co. at its power station at Barking, and also the help of the London Fire Brigade and the manufacturers of various proprietary media for dealing with fires.

Mr. McMahon introduced the report of the Committee and showed some colour films illustrating in a striking manner the starting and progress of the experimental fires and how they were extinguished. The length of the films taken amounted to 1¾ miles, about ten per cent of which were shown. The films were very instructive and many lessons were obtained from them. All the fires were artificially created and tests were carried out with methyl bromide gas, carbon dioxide, mechanical foam, chemical foam and water, as extinguishing media.

The recommendation made by the E.R.A. Fire Committee is that, for outdoor oil risks, the most suitable form of fixed installation is the atomized water type, or, if local conditions prevent this, then foam should be used. Failing either of them, inert gas media should be used, although when other media are available gas is not recommended. For indoor oil risks, it is stated that where weatherproof metal-clad gear is installed, atomized water will provide adequate protection, subject to precautions being taken to ensure that any apparatus not of the weatherproof type is not liable to suffer serious water damage. Where there are no draughts, gas protection can be applied, and although protection can be obtained with foam, there is the disadvantage that it leaves deposits which may hinder repair operations. For cables in enclosed spaces not liable to draughts, inert gas protection is effective under conditions of rapid operation. Difficulties may be encountered with water and foam. Much the same remarks are applied to cable galleries exposed to the atmosphere, and where gas is not safely applicable then water or foam installations will afford adequate protection. Certain recommendations are also made with regard to portable apparatus, and it is also recommended that back-up protection by means of water hydrants should be provided in case of emergency.

Mr. Nimmo, one of the Electricity Commissioners, remarked that whilst an examination of the films showed that the risk from oil is obviously so great that some might think that the use of oil-less switchgear should be enforced, yet it has to be remembered that there is a great deal of oil gear in everyday use, and steps have to be taken to protect it. In his opinion, water properly applied is the best medium; with the other media used in these tests, experts had applied them. The ordinary user is still left wondering which is the best to use. Usually it was applied by the station personnel. The cooling effect of water gives it a tremendous advantage over carbon dioxide, methyl bromide or carbon tetrachloride. Accepting this, he suggested that for outdoor and indoor transformers and oil and bitumen-filled switchgear, an automatic atomized water installation might be used, and for cable basements and cellars where oil is not likely to be present, ordinary sprinklers would suffice. Finally, he prefers a water pressure of 60 lb. per sq. in. and a ten minutes storage supply to the 50 lb. and four or five minutes recommended in the report.

Mr. C. M. Kerr, who is an officer of the London Fire Brigade and was also a member of the Fire Committee concerned with these tests, spoke of the difficulty of laying down hard-and-fast rules for dealing with these fires and emphasized the need of ample back-up protection; to this, he thinks, too little attention has been given in the report. He also mentioned the need for attention being given to the maintenance of the various forms of fire fighting equipment as a consideration in determining their choice.

Mr. H. Bright said that although the title of the report was "Fire Fighting Equipment for Electrical Installations", it dealt, as did the discussion, solely with power stations. There are, however, installations, such as those in places of entertainment and elsewhere, where the risk of life from oil fires is very much greater than in power stations. In such cases, certain of the media mentioned must be ruled out because of their toxic or suffocating effects. In such places, too, it would be impossible to drain the oil from the transformers into pits, as was suggested for power stations. The alternative seemed to be to have a large tank.

Mr. Hacking, who replied to the discussion, said that the word 'emulsification' was deliberately not used in the report, because satisfactory results had been obtained using water, when there was no question of emulsification. He agreed that the smoke detector should only be used as a detector.

INSECT PESTS OF CROPS IN ENGLAND AND WALES

By Dr. A. D. Imms, F.R.S.

BULLETIN No. 118 of the Ministry of Agriculture and Fisheries, recently issued, records the incidence of the more important crop pests for the years 1935–37. The information upon which it is based has been supplied in the main by the advisory entomologists and other reporters. It appears that numerous foreign insects were intercepted by the Ministry's inspectors during their examination of imported plants and others were sent in by the general public. The great majority of these aliens were unlikely to prove either injurious or to establish themselves in Great Britain. A few, however, were of a different category and need brief reference.

The Colorado beetle (*Leptinotarsa decemlineata*) was represented by a few individuals found in the vicinity of London and Swansea. For the most part they were known to have been introduced through shipping, but no outbreak occurred during the period under review. The chrysanthemum midge (*Diarthronomyia* sp.) first occurred as an outbreak in 1927 but, by 1930, the pest was reported to have been eradicated. After an interval of six years a new infestation was discovered in southern England and appears to have had origin in plants or cuttings imported from the United States. In order to render the position more secure in future the importation of chrysanthemums has now been prohibited, except under special licence, which prescribes rigorous precautions to be observed.

The asparagus fly (*Platyparea pœciloptera*) had not been previously noted in England until it was discovered by C. Warburton in a garden in Hertfordshire in 1935. Subsequent work carried out by the Ministry's inspectors showed that it is too widely established in that county to render any attempt at eradication practicable. The species is a serious asparagus pest on the Continent of Europe and its presence in England may result in the shortening of the productive life of the beds, but it is probable that reasonable commercial control will be attained.

During the period under review, while many of the regular pests of English crops were prevalent, relatively few are specially noteworthy. Mention, however, must be made of the codling moth, which caused very serious damage in most fruit-growing districts during 1935 although it was much less troublesome in the two succeeding years. On the upland pastures of mid-Wales and parts of northern England, outbreaks of larvæ of the antler moth caused loss of sheep-keep. Wheat and oats were seriously attacked by the aphid *Myzus festucæ* in 1935, large acreages in many districts being almost completely ruined. As with the codling moth, the attacks were much less evident in the other two years.

Among unusual records larvæ of the sword grass moths (*Polia vestusta* and *exoleta*) attacking hops and of the holly blue butterfly (*Lycæna argiolus*) injuring raspberries are of interest.

The bulletin also gives a summary of progress as regards insecticides and their application, and concludes with a useful list of references to papers published in Great Britain, during the triennial period, which are concerned with crop pests and related subjects. Viewed as a whole the situation is very satisfactory. Possible danger from the introduction of the apple maggot from Canada and the United States and of the cherry fruit fly from various European countries has been reduced to small proportions by timely action being taken. Also the well-organized watch kept for the Colorado beetle has amply justified itself, since no outbreak has occurred; yet, on the Continent of Europe, its spread eastwards extends yearly and it now has an almost continuous range from southern France to central Germany.

SEVENTY YEARS AGO

NATURE, vol. 1, March 3, 1870

Natural Science at Cambridge

THE Rev. T. G. Bonney, the geologist, concluding an article on this subject, writes: "I may venture to express my conviction, that the coldness and even dislike with which the study of Natural Science was once regarded here is rapidly passing away, that the number of earnest students in the various branches is annually increasing, and that the University is fully alive to the wants of the age; so that, while she can never neglect or forget those old paths of Classics and Mathematics in which many of her sons have won an almost world-wide reputation, she will heartily welcome, and will regard with no less pride, all who are among the followers of sciences of a more recent date."

Measurement of Geological Time

ALFRED RUSSEL WALLACE presents the second and concluding article on this topic. He discusses, in particular, the effects of denudation as shown by Geikie's investigations. Surveying the estimates made by Tylor, Croll, Geikie and Lyell, he deduces a scale of geological time ranging from 24,000,000 years for the beginning of the Cambrian, to 2,000,000 years for the beginning of the Lower Miocene. He continues: "These figures will seem very small to some geologists who have been accustomed to speak of 'millions' as small matters; . . . Taking Sir William Thomson's allowance of a hundred million years for the time during which the earth can have been fit for life, it yet allows Mr. Darwin, for the process of development from the primordial germ, three times as many years anterior to the Cambrian epoch as have elapsed since that date, an amount of time which, I believe, will fully satisfy him, by whatever scale we may measure it."

Industrial Use of an Electric Motor

"FOR many years it has been a query whether the electric current might not be brought so far under man's control as to take the place of steam as a motor for machinery, and success has at last crowned the persevering efforts of scientists. At the last exhibition of the American Institute, there was seen an elliptic lock-stitch sewing machine, driven by a small electric engine which might easily be put into a common hat box. . . . The use of this motor, if it becomes general, cannot fail to prove of the utmost benefit to ladies, especially to machine operators, as it does away entirely with the necessity for using the feet, as is now the case, and must be highly conducive to the health of females, who suffer from many diseases that are generated by the constant strain on the pedal and limb muscles. The inventor of the engine in question is Charles Gaume."

"MR. E. RAY LANKESTER has been elected by examination to the Radcliffe Travelling Fellowship at Oxford."

THE *American Gaslight Journal and Chemical Repertory* states that Professor Loomis, who claims to have discovered a way to transmit messages by electrical air currents without the aid of wires, wants to be appointed Consul to some European port, that he may experiment on the summit of Mont Blanc.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TWO TEACHERS OF ENGLISH in Timisoara and Iasi—The British Council, 3 Hanover Street, W.1 (quoting 'Rumania') (March 9).

TECHNICAL ASSISTANT in the Mechanical and Electrical Engineer's Section—The Engineer and Manager, Waterworks Department, Town Hall, Manchester 2 (March 16).

ONE SENIOR ASSISTANT and SIX ASSISTANTS for Evening Institutes in Egypt—The British Council, 3 Hanover Street, W.1 (quoting 'Egypt') (March 18).

DIVISIONAL ENGINEER (WIRELESS) for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9134).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry, Leaflet No. 7: Carbon Monoxide. Pp. iv+9+2 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [142

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 793, Vol. 238: Stress Functions for a Plate containing Groups of Circular Holes. By Dr. R. C. J. Howland and Dr. R. C. Knight. Pp. 357–392. 6*s*. No. 794, Vol. 238: Crystallographic Studies of Meteoric Iron. By J. Young. Pp. 383–422. 6*s*. 6*d*. No. 795, Vol. 238: The Asymptotic Expansion of Integral Functions defined by Taylor Series. By Prof. E. M. Wright. Pp. 423–452. 4*s*. (London: Cambridge University Press.) [142

University of London Institute of Archæology. Geochronological Table No. 1: An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China. By Wen-Chung Pei. (Occasional Paper No. 2.) Pp. 16+2 tables. (London: University of London Institute of Archæology.) 2*s*. 6*d*. [142

The Carnegie Trust for the Universities of Scotland. Thirty-eighth Annual Report (for the Year 1938–39) submitted by the Executive Committee to the Trustees on 12th February 1940. Pp. iv+90. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [142

Imperial Bureau of Plant Breeding and Genetics. Field Trials: their Lay-out and Statistical Analysis. By Dr. John Wishart. Pp. 36. (Cambridge: School of Agriculture.) 2*s*. 6*d*. [142

Other Countries

Imperial Council of Agricultural Research, India. Scientific Monograph No. 13: Further Observations on Anatomical Deviations in the Ox and Notes on Certain Anatomical Freaks. By H. N. Chelva Ayyangar. Pp. vi+42+31 plates. (Delhi: Manager of Publications.) 2.8 rupees: 4*s*. [142

Reports of the Biochemical Research Foundation of the Franklin Institute. Vol. 5, 1938–1939. Pp. vii+42 papers. (Philadelphia: Franklin Institute.) [142

Transactions of the National Institute of Sciences of India. Vol. 2, No. 2: Changes brought in Colloids by Dialysis. By Dr. B. N. Desai and P. M. Barve. Pp. 39–68. (Calcutta: National Institute of Sciences of India.) 3 rupees. [142

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 12: The Kimberlite Province and Associated Diamond Deposits of Tanganyika Territory. By Dr. G. J. Williams. Pp. 41+3 plates. (Dar es Salaam: Government Printer.) 3*s*. [142

Indian Forest Records (New Series). Entomology, Vol. 5, Nos. 4, 5, 6: On the Biology of the Parasites of the Teak Defoliators, *Hapalia machæralis* Walk. (*Pyralidæ*) and *Hyblæa puera* Cram. (Hyblæidæ) in Burma, by P. F. Garthwaite and M. H. Desai; Further Notes on the Biology of Parasites of Teak Defoliators in India, by C. F. C. Beeson and S. N. Chatterjee; On the Biology and Morphology of *Apanteles machæralis* Wlkn. (Braconidæ, Hymenopt.), by P. N. Chatterjee. Pp. ii+309+396. (Delhi: Manager of Publications.) 2 rupees; 3*s*. [142

Dominion of Canada: Department of Transport, Air Services Branch: Division of Meteorological Services of Canada. Canadian Polar Year Expeditions, 1932–33. Terrestrial Magnetism, Earth-Currents, Aurora Borealis: Chesterfield Inlet, Meanook, Saskatoon. Vol. 2. Pp. 185. (Ottawa: King's Printer.) [142

Instituto Nacional de Tecnologia (Ministerio do Trabalho, Industria e Comercio). O controle de concreto numa construção. Pelo Alberto Pastor de Oliviera. Pp. 21. Dosagem racional em tubulação de concreto. Pelo Adhemar da Cunha Fonseca. Pp. 52. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [142

Catalogues, etc.

The Basic Cause of Ill-Health. By K. Cookson. Pp. 20. (Slough: Cooksonisers (Slough), Ltd.)

Pyelectan for Intravenous Pyelography. Pp. 2. Kapilon for Vitamin K Therapy. Pp. 2. (Greenford: Glaxo Laboratories, Ltd.)

Industrial Thermometers, Hygrometers, Manometers. (List No. 641.) Pp. vi+64. (London: C. F. Casella and Co., Ltd.)

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ECONOMIC WARFARE AND NATIONAL EFFORT

THE dominant conclusion which emerges from the admirable surveys of the work of the Department of Economic Warfare which Mr. Ronald H. Cross has recently given in the House of Commons and in a broadcast talk is that economic warfare is a field which demands very deliberate application of scientific methods if success is to be achieved. Nothing short of a really militant policy, taking full account of the known facts and undeterred by other considerations than its main purpose—that of making it as difficult and as expensive as possible for Germany to obtain her supplies—can be adequate. The task is from the outset more difficult than it was in 1914–18, for Germany now has access by land to the whole of Europe east of France, as well as to the greater part of Asia. We cannot afford to neglect loopholes which might be stopped by more efficient organization or a more scientific policy.

One of the great merits of Mr. Cross's surveys is that they direct the attention of the public not only to what is being done but also to the expansion of that work which is still required. That expansion will demand the co-operation of the public to an extent which will only be possible as a result of a really scientific policy and effective campaign of education. There are many, indeed, in Great Britain who still imagine that we shall win the War without undue disturbance of ourselves. Such easy optimism should at least be shaken by these addresses of Mr. Cross. The discipline already accepted by Germany is not so much a sign of defeat as a challenge that must be taken up by all the democracies. Victory in the great cause for which they contend can only be assured by sacrifices worthy of so great a goal and in no way inferior to those which have been accepted by the enemy.

The accounts which Mr. Cross has given of action taken and projected, however, still afford grounds for the uneasiness with which the Government's attitude in this important matter is regarded in many influential quarters. The concern which has been expressed by Sir William Beveridge and others that the War Cabinet contains no member designated as Minister of Economic Co-ordination or indeed who would appear well fitted for that part, was not dispelled by Lord Stamp's appointment as adviser to a Cabinet Committee on Economic Co-ordination. Recent events, such as the lack of foresight betrayed in a recent debate in the House of Commons on the home production of foodstuffs, have indeed increased it.

Conceived even within the sphere of the Ministry of Economic Warfare, economic warfare is essentially a scientific problem, with all the difficulties involved in conducting operations which bear no relation to normal sound business. So long ago as November an able article contributed to *The Times* argued for an organization on a geographical basis with an economic commander-in-chief, assisted by a small expert economic general staff, corresponding with the organization at the disposal of a military commander-in-chief. Much more is the immense dislocation involved in our transition from a peace-time to a war-time economy a scientific problem which is still incompletely solved. The persistence six months after the outbreak of war of the tragic waste of employment on the scale of a million and a quarter testifies to the absence of organization to utilize the abundant resources which we possess.

These are among the main considerations which have led to renewed representations for reconstruction of the Cabinet, and administrative machinery on lines which would enable all the activities on the economic front to be co-ordinated as parts of one coherent policy for the vigorous and effective prosecution of the War. Among other speakers, Lord Swinton urged that the Cabinet should include a Minister standing in the same relation to the economic department that the Minister for the Co-ordination of Defence does to Service departments. It is true that Lord Stamp is building up a central staff; he has been assisted from the start by Mr. Henry Clay and Mr. H. D. Henderson. Prof. J. Jewkes has now been summoned from Manchester and Mr. E. A. E. Robinson from Cambridge, and it would be unjust to infer that Lord Stamp and his staff are offering no advice on prices, wages, labour mobilization, exports or finance, because the Government has no apparent policy on these matters.

It would appear to be probable that everything that machinery for interdepartmental coordination can achieve is already being done through the committee of permanent heads of departments of which Lord Stamp is chairman, or the Economic Policy Committee of the Cabinet, with Sir John Simon in the chair and Lord Stamp in attendance. What is wanted is central and purposive direction applied not only to interdepartmental matters but also to those that are, formally at least, the concern of one department. Only a Cabinet Minister of Economic Co-ordination can be expected to possess the authority and decision necessary to overcome the obstacles presented by the *laissez-faire* attitude of the Board of Trade in regard to exports or location of industry, the negative views of the Ministry of Labour on its own functions or the inadequate conception of the Ministry of Supply, with its autonomous and secretive controls. The advisability of giving careful consideration to the reconstruction of the Cabinet on the lines recommended by the Machinery of Government Committee of 1918 is more and more apparent as the struggle proceeds.

The administrative problem may be one of scientific management, of bringing into the executive and administrative machinery of government the principles which have been elaborated and tested in large-scale industrial and business organizations and indeed in the Services themselves. The extent to which the whole economic effort of the nation is a problem demanding close scientific analysis is indicated further in an admirable survey of civil needs issued as a broadsheet by P E P (Political and Economic Planning) almost simultaneously with the recent debates on economic warfare in the Houses of Parliament. It reminds us, as did the statements of the Minister of Economic Warfare, of the inexorable demands which war makes on us and the inevitableness of personal sacrifice. It also indicates the chaos and danger which may well result if no guidance is given as to cutting down of unnecessary consumption, and no attempt made to define essential civil needs on a rational basis in relation to the elimination of waste, the conservation of our resources and the most effective implementing of our war effort.

In regard to food, for example, that primary and most essential need, if we are to minimize our large imports of foodstuffs without detriment to standards of nourishment, we must make the best use of the food we consume, by utilizing to the full the discoveries of nutritional science during the last twenty years. Moreover, besides the problem of putting everyone in the position to buy the necessary minimum of foodstuffs, there is the further problem of ensuring that those who can afford enough food are not malnourished through ignorance or physical reasons. Where people are already malnourished to the detriment of their efficiency as workers, an unplanned cut in food consumption would undoubtedly increase this malnutrition and inefficiency. At the same time, a proper use of our knowledge of nutrition might enable us to reduce our gross consumption of foodstuffs without any loss, and perhaps even with an increase, of health and efficiency.

The imposition of rationing without such positive action clearly holds dangers. Both eating and cooking habits may require drastic changes if we are to make the best use of our existing supply of foodstuffs and of the reduced supply which war will inevitably entail. There must be an end to the unbalanced or prejudiced pushing of particular food commodities in the private interests of the seller.

The economic use of the national food supply is largely a scientific question, but it will require firm direction; and national interests must override all other considerations in determining the distribution of such commodities as, for example, barley, between the farmer or smallholder and the brewer. It will be remembered that in 1916 the Royal Society Food (War) Committee, recommending that feeding-stuffs should be fed only to good 'converters' such as dairy cows, calves and pigs, and the production of cheese instead of butter, recommended also the partial or total prohibition of brewing. Moreover, the dependence of British agriculture itself upon imported feeding stuffs raises other problems in relation to the reduction of imports, from the point of view of saving tonnage or of exchange.

Generally, it requires more shipping tonnage to import food for animals than to import food directly for men and women. A shift in agriculture to good 'producers' as recommended by the Royal Society Food Committee would involve a considerable reorganization of British agriculture. Land formerly used for growing fodder is being turned over to growing food for human consumption. The most effective use of the maximum average which must be the objective of British policy can only be secured by making the fullest use of the scientific knowledge available. Such a utilization, coupled with an effective education campaign, leading us to eat differently, involving sacrifice of some imported foodstuffs, and a measure of reorganization in agriculture, should make it possible to reduce our expenditure on food with real advantage to our war effort.

The housing situation also requires scientific analysis and treatment. If it is probable that the civil need for housing can be satisfied during the War at very little cost, the impact of a large reduction in net expenditure on housing not only on the building industry but also on the public works contracting industry, the furniture-making industry and numerous auxiliary industries requires consideration. The appropriate utilization of displaced workers from these industries is a major problem of social planning which has yet to be tackled. After the War, and during it, if there be large-scale air raids, the building industry will occupy a key position. Careless disposal of the key personnel such as architects, quantity surveyors and skilled workers might have serious consequences.

Similarly, national expenditure on transport demands close and scientific study. The possibilities in the elimination of excessive expenditure on daily journeys, with all the advantages that might accrue in the saving of health and time as well as transport, have yet to be examined. Staggering of hours and holidays may become inevitable as available transport facilities are restricted, and economies in expenditure on private transport should in turn reduce the annual deterioration on the roads. Moreover, the development of alternative sources of power in place of petrol for transport is a further and essentially technical problem.

In many other spheres such as clothing, the use of fuel and water supplies, much could be done to eliminate waste by suitable publicity campaigns. The prevention of atmospheric pollution by more efficient means of utilizing coal in domestic houses and the prevention of riparian pollution are two examples in which the co-operation of scientific workers is important. They could also play their part in directing attention to the preventable waste which occurs through ill-health, the ravages of rabbits, rats, weeds, insect pests or animal pests, through neglect to employ scientific methods of control.

There can be no question as to the seriousness of the economic situation. Direct economic warfare is only one of its facets; equally intense drives are required elsewhere to ensure concerted and intelligent thinking, the elaboration of plans based on adequate scientific knowledge and their translation into immediate and appropriate action. The absence of signs of an adequate plan, of organized thinking and resolute action are disquieting aspects of the situation at the present moment.

We cannot escape, as war proceeds, inroads into our standard of living, and so far the Government has lagged far behind that of France in putting before the people the need for sacrifice. Something more than vague generalities is now required. Should it be decided to adopt the plan of a basic 'iron ration' advocated by Prof. J. R. Hicks, fixing rations of a basic list of necessary commodities, corresponding with basic human needs, at guaranteed prices which would ensure that the whole ration would never cost more than a stated sum within the reach of all, the Government can only win the support of a free people by giving evidence of the most rigorous and impartial examination of the situation, and of its own capacity to take the resolute action demanded. We may well have cause to be grateful if the recent utterances of the Minister for Economic Warfare herald a much closer attention to the economic aspects of the War and a scientific examination of the situation which may give concrete guidance to the call for economy and sacrifice.

COLONIAL DEVELOPMENT AND RESEARCH

WHEN on February 20 the House of Commons turned for a brief space from its preoccupation with the War to listen to Mr. Malcolm MacDonald, H.M. Secretary of State for the Colonies, as he announced the decision of the Government in the matter of the report of the West India Royal Commission, 1938–39, it must have been a source of both pride and gratification to the members that, at a time when every resource is strained in the effort to preserve all for which our society and system of government stand, the loyalty and support which the mother country has received from her colonial dependencies should be met by a no less striking manifestation of solicitude on the part of Great Britain for their inhabitants. As already pointed out (see NATURE, March 2, p. 342), the statement of future policy in relation to the development and welfare of the colonies then made by Mr. MacDonald* not only marks a new departure in the relations, financial and other, of the central and local administrations, but it also extends vastly the field in which the sense of responsibility of the mother country for the well-being of the inhabitants of these territories will be enabled to find effective expression. This inter-relation is well defined in the words of the statement itself, that His Majesty's Government, regarding themselves as "trustees for the well-being of the peoples of the Colonial Empire", look upon "the spontaneous and wholehearted support given by the inhabitants of every territory to the common war effort as the best testimony to their appreciation of the way in which that trust is being discharged" ; while on the other hand, it is said, "the primary aim of Colonial policy is to protect and advance the interests of the inhabitants of the Colonies (in which term are included . . . Protectorates and Mandated Territories)".

Mr. MacDonald's announcement is the outcome of no hasty and improvised decision. Indeed, it is stated that this further development of Colonial policy was settled in principle some time ago, and final decisions were postponed only pending the result of the West India inquiry. It has been evident for a considerable period that circumstances, aggravated by the economic depression, not only militated against the social and economic well-being of the inhabitants of, for example, the African dependencies under the Colonial Office, but also were rapidly approaching a stage at which drastic remedial measures, beyond the resources of the local administration, would have to be applied. It is now pointed out that while much has already been accomplished, there is room for further active development of the natural resources of the various territories so as to provide their peoples with improved standards of life.

The conclusion at which the Government has arrived, after consideration of the effect of such limited resources derived from agriculture as are available in most of the dependencies, in relation to a policy of steady development, is that many colonies cannot finance out of their own resources the research and survey work, the schemes of major capital enterprise, and the expansion of administrative and technical staffs, which are necessary for their full and vigorous development. The old principle that a colony should have only those services which it can afford to maintain out of its own resources is to go by the board, and in future, assistance will be given not merely for capital expenditure or material development—in the main the objects of the Colonial Development Fund instituted in 1929—but also the money from new sources now to be provided is to be made available for the maintenance of important works or services over a substantial period of years.

For the sake of clearness, it may not be out of place here to recapitulate briefly the financial arrangements now proposed, and the machinery to be instituted for their employment.

The Colonial Development Fund, instituted in 1929 and limited to a maximum of £1,000,000 a year, will be replaced by a new vote in the estimates for assistance to Colonial Governments up to a maximum of £5,000,000 a year for ten years. This assistance will be available not only for schemes involving capital expenditure for colonial development, but also for helping to meet recurrent expenditure on certain services, such as agriculture, education, health and housing.

Bearing in mind the proposals for research made by Lord Hailey in his "African Survey", the Government proposes to make special provision for research. Hitherto, expenditure on various forms of Colonial research has received assistance from the Colonial Development Fund. In future, for this purpose a separate sum will be allocated up to a maximum amount of £500,000 a year.

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* Statement of Policy on Colonial Development and Welfare. (Cmd. 6175.) Pp. 8. (London: H.M. Stationery Office, 1940.) 2*d*. net.

As regards the manner of allocating expenditure from these funds, the Government will enlist the help of a Colonial Development and Welfare Advisory Committee, which will be composed partly of official and partly of unofficial members.

In the province of research, in the past the authorities have had recourse in dealing with questions of Colonial research to the advice of scientific and technical experts in Great Britain; but they are now anxious to place the system on a wider and more regular basis. It is considered that this object can be best achieved by the establishment of a Colonial Research Advisory Committee. It is not anticipated that the full scale of expenditure will be reached all at once, especially in present conditions; but so far as possible, steps will be taken immediately to give these proposals effect.

It will be seen that this extension of policy in colonial development represents a very appreciable step in advance. Its most marked effects should be immediately apparent in the removal of the restrictions which virtually, if not in terms, confined previous grants-in-aid to non-recurrent capital expenditure and material development. In no departments of colonial administration have efforts at amelioration been so cramped as in the provision for health services and education—both of paramount importance in raising the standard of well-being among the native populations. By a prolonged course of education alone can the object of the health services really be fully attained.

It is natural that in this much enlarged policy of colonial development the first emphasis should be laid on the improvement of the economic position of the Colonies. Although in any consideration of the amelioration of colonial conditions it has come to be almost a matter of course to consider how and in what way the native population is affected, the interests of the white settler are not to be overlooked. On his shoulders in most instances rests the main burden of the development of the natural resources of the territory; and anything which contributes to promoting the improvement of economic conditions must be to his advantage as well as a further stage in progress towards self-sufficiency.

At the same time, even in such conditions, as always, the foundation of the social and economic structure is the native population. It is this consideration which weighs the argument when it is urged that whatever delay may be imposed on development by current conditions and the claims of the vigorous prosecution of the War, some part at least, and that the more urgent, of the expenditure on research may be pressed forward as a first and immediate charge. Among subjects of inquiry, a plea must be put forward for intensive study of the forms and constitution of native society. That the claims of this line of investigation should be stressed at this late date may seem a work of supererogation. Yet it is a question whether even yet the essential need of intensive study of native institutions and beliefs, and the implications of its conclusions, have been fully recognized, even though anthropologists have been attached officially to recent survey work, such as the nutritional survey in Rhodesia; indirect rule itself, prior to its application, requires an investigation of the character of native institutions before it is possible to make use of them in the administration of native affairs. Recent investigations in West Africa, for example, suggest that indirect rule, where it is now in being, may sometimes rest on an uncertain foundation, notwithstanding preliminary inquiry, when dealing with so complex a matter as the seat of authority in an African community. The farther and deeper goes research in the social anthropology of African peoples, the more patent becomes the closely woven nexus of social and religious or quasi-religious relations of the community. It is impossible to touch the part without affecting the whole.

The significance of further and intensive research in social anthropology as a priority condition of the application of measures of colonial development affecting the native should be obvious. There is no measure of amelioration, whether it be in health, nutrition, agriculture, land tenure, education, housing, or social reform generally, which does not necessarily impinge upon, and to some extent modify, some sides of native life. What those sides are, how extensive their ramifications, and to what extent they may introduce further and unanticipated changes in mode of life, to the disadvantage of the community, the anthropologist is better able than anyone else to say. Many mistakes, reacting to the disadvantage of the native population, have been made in the past in default of such expert guidance. The delay which must supervene in the full application of the new policy of development at least gives opportunity for their avoidance from this cause in the future.

THE PLACE OF SCIENCE IN BRITISH AGRICULTURE

Agriculture in the Twentieth Century
Essays on Research, Practice and Organization to be presented to Sir Daniel Hall. Pp. x+440. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 15*s*. net.

BRITISH agriculture has always had its problems, its vicissitudes, its hopes; and although still buffeted by forces political, economic and social, it keeps its head erect, conscious of its unique importance and maintaining an undying faith in the return of better times. One impression gained by reading these excellent essays, written by leading exponents of scientific agriculture, and most fittingly dedicated to its Nestor, Sir Daniel Hall, is that of the great difficulties confronting statesmen and administrators when they have to adjust their outlook and their policies to meet new situations, which, in the absence of any long-term plan, have come upon them unforeseen. Until Sir Daniel Hall was appointed to the Development Commission in 1909, scientific knowledge and foresight seem to have been conspicuously lacking in administrative circles, and even to-day they have to contend with reactionary forces, represented by vested interests, the ignorance of science, and that one and only static thing in an ever-changing world, the ultra-conservative mind.

Of the fifteen essays included in the book, four deal exclusively with the relations of agriculture to the State or public authorities, and the rest to scientific and technical advances, mainly in the last forty years. The essays adequately cover all branches except that of agricultural engineering. Mr. H. E. Dale, formerly principal assistant secretary to the Ministry of Agriculture and Fisheries, has some interesting things to relate about Civil servants, whose traditional silence keeps the outside world uninformed of their functions and powers. He admits that order and strength, and not flexibility and freedom of personal initiative, are their peculiar virtues, and tells us that they are as averse from official intervention in the business of agriculture as are the farmers themselves. The growth of this intervention has arisen from the urgent need of keeping agricultural producers on their feet. The policy of assisting home producers by supporting prices, or by compensating them for price reductions due to world conditions, has been the dominant note of all recent legislation; unfortunately, as several writers point out, it has not been accompanied by any direct legislation, for example, on distribution costs, to help the consumer. Dr. J. A. Venn shows how the annual cost of supporting agriculture has lately run into a sum of the order of £60 million. Prof. H. H. Ashby contributes a dispassionate digest of agricultural legislation since 1910, but shows his teeth when he writes: "Neither the State nor agriculturists have ever defined the chief aims of agricultural policy, and for the greater part of the time both parties are pursuing conflicting and to some extent mutually destructive aims". Prof. J. A. Hanley recounts the rise and progress of agricultural education since its beginning in 1890, ending on a cheerful, if controversial, note that "the attitude of farmers and farm workers towards education and research has changed completely—their confidence has been won".

Less optimistic is Prof. C. S. Orwin in his account of "The Farmer's Business". He states that "the evolution of the industry has stopped short at a point half-way between peasant production and scientific management". He urges strongly the use of simple accountancy methods by farmers, but has to deplore that "the practice of scientific book-keeping, as the only means to correct the policy and the practice of the farmer, is so rare as to be virtually non-existent".

Prof. J. A. Scott Watson writes more cheerfully, acknowledging fully the many advances made by applying science to practice. He admits, however, that there has been no essential advance in the art of tillage, and states that "the recipe for success in breeding [stock] is still an ounce of science to a pound of intuitive judgement and half a stone of luck".

In the essays dealing mainly with scientific and technical developments, some of the authors pursue a rigidly historical sequence, which is apt to make 'heavy' reading, whilst others concentrate on the present position using history as a background. Notable among the latter are Sir John Russell's lucid account of "Soil Science in England", and the valuable essay by Dr. C. Crowther on "Some Problems of Animal Nutrition". Sir George Stapledon's treatise on "Grassland" deserves special attention as coming from the pen of a pioneer, a thinker who has shed his academic blinkers, and—one must add—as a 'feeler', for he confesses: "I am sufficiently unscientific, or possibly sufficiently scientific, to permit feeling to colour my scientific judgements and opinions". Dr. R. N. Salaman has a fascinating tale to tell about the rise and progress of research in plant viruses: and Mr. R. G. Hatton's account of developments in fruit-growing discloses a remarkable story of scientific achievement which is probably unknown to most of those who do not work in his field.

The technical essays, in particular, will be of great value to students of scientific agriculture (and for this reason the book should have been provided with an index), and if they are read by the humanist, they can scarcely fail to convince him that although progress may often originate with the practical craftsman, it is science alone that can evaluate inventions and discoveries, stabilize them, and use them as a basis for further advance. It is probably true to say that in the last forty years—the period covered by the book—science has been responsible for many more advances than has untutored practice. And by science we mean controlled observation, measurement, and sound reasoning, not (with due respect to Sir George Stapledon) "feeling", although it may play its part in stimulating research and in applying the results to human betterment. Regarded as literary efforts all the essays are well-phrased and lucid. The only criticism that can be advanced is that some of them are rather overburdened with facts ; a little more play of the scientific imagination, a few more generalizations and ideas, and a livelier style of writing would have leavened the whole and increased its general appeal. Nevertheless, the book is in every way a notable one, and a worthy tribute to an exceptionally worthy man.

E. H. TRIPP.

ELECTRON DIFFRACTION

Theory and Practice of Electron Diffraction
By Prof. G. P. Thomson and Dr. W. Cochrane. Pp. xii+334+10 plates. (London : Macmillan and Co., Ltd., 1939.) 18*s.* net.

THE chief interest attached to electron diffraction at the time of its discovery was the abundant support it brought to the new and exciting ideas regarding a wave mechanics of material particles which de Broglie, Schrödinger and others were then applying with such marked success to the remodelling and rationalization of the Bohr atom. The discovery that electrons are diffracted by crystals left no doubt concerning the reality of the waves associated with matter, and the gratifying agreement between observed wavelengths and those calculated from de Broglie's formula afforded welcome evidence of the correctness of the wave model of the atom and of wave mechanical conceptions in general. The waves associated with matter had, so to speak, been brought into the open, and made available for direct examination.

It is not surprising that experimenters and theorists flocked 'in all directions', as the Russians have it, to this new field. Electron diffraction, like other recently discovered effects in these days of high-pressure research, enjoyed a period of intensive, not to say feverish, investigation during which the main facts and implications of the phenomenon were quickly laid bare. The technique of producing and recording patterns was rapidly improved, particularly for electrons of high speed. All diffraction effects observed with X-rays were shortly duplicated with electrons, including diffraction by molecular gases. The first rough checks of the de Broglie formula were confirmed by precision measurements. The first attempts were made to polarize electron waves by reflection. The relative intensities of diffraction beams were used to calculate the structure factors of crystals and form factors of atoms, with results in general accord with expectations based on existing theory. The dynamical theory of electron diffraction was developed along lines paralleling those followed in the theory of X-ray diffraction. Further, what now seems of prime importance, G. P. Thomson made the first applications of electron diffraction to the study of corrosion films on metal surfaces.

These developments were greatly facilitated by the huge store of knowledge and experience which had accrued from more than twelve years of intensive study of X-ray diffraction. The investigators of electron diffraction had at hand not only a model and guide for their work, but also an enormous fund of data regarding crystal structure and constants. There was some feeling at the time indeed that this store was rather more enormous than one might wish. All the 'easy shots' in crystal analysis had already fallen to X-rays ; electron diffraction had arrived only in time for the cheering —or so it seemed. It was recognized that electrons were suited to the study of exceedingly thin films and to surface layers—fields from which X-rays, because they are scattered but feebly by atoms, are excluded—and that here much of importance was to be learned. It is doubtful, however, if anyone realized how extensive and rich a field this is ; if anyone realized that in their respective fields, electrons would, in certain respects, be more useful for the analysis of crystals than X-rays.

The flow of energy in the primary electron beam is much greater ordinarily than that in the primary X-ray beams. The exposure times for electrons are consequently shorter (of the order of one second) and patterns are recorded at a greater rate, in spite of the fact that with electrons a vacuum must be broken and re-established at frequent intervals for changing plates and specimens. The wave-lengths of high-speed electrons are much shorter than those of the characteristic X-radiations, and this also is advantageous as it results in a greater content of information in the diffraction pattern per unit solid angle about the primary beam. Electron patterns which show twenty-five or thirty Debye-Scherrer rings are not uncommon, and patterns have been obtained which show as many as forty.

Even in the matter of diffraction phenomena, electrons have produced effects not observed with X-rays. The so-called cross-grating patterns, produced by the copious scattering of the extremely short electron waves, are of this class, as are also the Kikucki line patterns which reveal the diffraction of electrons elastically scattered in random directions within a crystal.

All these matters and much else beside, Thomson and Cochrane have set forth in a scholarly and pleasing manner in this new and welcome book on electron diffraction—the first of its scope in English. About one third of the book is devoted to theory. A chapter on general considerations of wave phenomena is followed by more particular examination of the concept of material waves, of crystal structures and diffraction effects. Ewald's invaluable conception of the reciprocal lattice is explained and employed throughout in the interpretation of patterns. Bethe's dynamical theory of electron diffraction is explored in considerable detail in a later chapter, and in another Darwin's theory of polarization is briefly reviewed.

The greater part of the book is given over to experimental technique and to a critical examination of results so far obtained in investigations of thin films and surface layers of gross specimens. Separate chapters are devoted to oil and grease films on metal surfaces, to oxide layers, and to the still controversial question of the physical nature of surfaces which have been mechanically polished. A chapter on the diffraction of low-speed electrons serves chiefly to reveal how much is yet to be learned in this important field. Elsewhere, also, one is struck not only by how much has been accomplished but also by the vast amount of work still to be done. The book is not free from errors: What book in its first edition is? But such as have been noted are few, obvious and innocuous. The authors are to be congratulated on having produced a timely survey and appraisal of our present stock of knowledge regarding the diffraction of electrons.

C. J. DAVISSON.

DESIGN IN AIRCRAFT

Aircraft Design

Vol. 1: Aerodynamics. Pp. xii + 215 + 8 plates. 13*s.* 6*d.* net. Vol. 2: Aerostructures. Pp. xiii + 308 + 10 plates. 16*s.* net. By C. H. Latimer Needham. (London: Chapman and Hall, Ltd., 1939.)

IT is difficult to assess the value of these two books without understanding to whom they are addressed. The author's treatment of his subject is more applied than academic, making it appear to be a designer's handbook rather than a student's text-book. Even then "he falls between two stools", giving neither enough facts and figures for the one, nor fundamental proofs for the other. Nevertheless the subject matter, so far as it goes, is useful and logically treated, and the volume should find a place in any library of aeronautical literature.

Vol. 1, "Aerodynamics", could have been better named "Aerodynamic Design"; it treats the subject entirely from this point of view. In this respect the author has made some unfortunate choices in his examples. In the remarks upon the properties of aerofoils, R.A.F. 15 is the one chosen. This has long been of nothing more than academic interest to the designer. The chapter dealing with the variation of the properties of an aerofoil with its shape is an excellent concept, and gives the designer exactly the lead that he so often needs, having to produce an aerofoil to fulfil a certain performance. The discussion of the effect of Reynolds' number on drag is dangerously vague, and no mention is made of the fact that the roughness of the surface is a vital factor when using results comparatively. Also the effect of structural form, biplane or monoplane, and plan form on induced drag seems to be none too clear.

The chapters on variable lift devices and air-screws are good, being more of an applied nature, but a fuller reference to B. M. Jones's classical method of drag analysis would have been valuable.

Vol. 2, "Aerostructures", is much more clearly defined in its presentation, and gives the impression that here the author is more at home with his subject. Again his choice of examples might have been more up to date. His figures for the comparison between a biplane and a monoplane are based on practice of several years ago. There is an excellent chapter on weight distribution and its estimation, a subject which has seldom been treated properly or as fully in other published text-books. Load factors are also dealt with fully, another subject none too clearly treated in other books. Mention should have been made of the possibility of these being varied as our knowledge of the principles of aerodynamics is extended.

When the author reaches the really practical aspects of design in chapters such as wing design, under-carriages, and metal construction, he becomes very sketchy in his treatment. It is, of course, impossible to treat such subjects in any other fashion in so small a compass, and it might have been better to have covered a smaller field more thoroughly. For example, a chapter on testing scarcely comes within the province of "Aircraft Design". The subject-matter in these chapters is accurate and useful so far as it goes. One is tempted to hope that the author will find it possible to extend future editions, and give his readers the benefit of the detailed knowledge of this part of the subject that he obviously possesses.

PROGRESS IN BIOCHEMISTRY

Annual Review of Biochemistry
James Murray Luck, Editor ; James H. C. Smith, Associate Editor. Vol. 8. Pp. ix+676. (Stanford University P.O., Calif: Annual Reviews, Inc., 1939.) 5 dollars.

THE editors emphasize the need for critically appraising contributions of major significance rather than attempting a mere catalogue of papers, so that presumably this year's reviews, of which there are twenty-five, have been written from this point of view. Even so, they are mostly so highly specialized as to be too difficult for anyone but the experts.

Under the heading biological oxidations, Mr. Dixon notes the discovery of a new coenzyme-nucleotide and of new catalytic flavoproteins. In point of fact, rapid progress is being made in this group, but it requires a year or two yet before the results can be pulled together and a clear story made out of them.

The enzymes are dealt with in two sections, proteolytic and nonproteolytic. The work is now mainly chemical and slow progress is being made. K. Myrbäck devotes a few pages to the discussion of the various amylases : it is now admitted that they belong to clearly different groups producing from starch either alpha maltose or beta maltose or stable dextrins which vary in nature. It is inferred that the starch molecule cannot be so simple as deduced from the formula of Haworth. What a difficult problem starch presents ! It has perhaps the largest literature of any compound and is one of the commonest of substances.

Karl Freudenberg selects lignin for discussion among polysaccharides and has put forward what seems to him the most logical conception of spruce lignin structure. The fundamental type unit, a skeleton containing nine carbon atoms, is a substituted phenyl propane, and it is considered that lignin is composed of a number of similar units connected through an ether linkage between phenol-hydroxyl and the carbinol group of the side chain. The origin of lignin in the plant can only be conjectured. It may come from pectin, but it is more probably derived directly from hexoses. The relation of lignin to the many phenolic glycosides also requires consideration. X-ray studies are doing so much to advance the knowledge of the structure of compounds of biological interest that it is valuable to have a note on this subject from W. T. Astbury.

Chapters follow on fats, proteins, and sulphur compounds and on several branches of metabolism.

There is more work on hormones than ever, particularly in the steroid group relating to sex and adrenocortical hormones. John Freud and two other Dutch workers contribute a very useful summary in which they cite 550 papers and books. The vitamins are distinguished as water-soluble and fat-soluble. There is an interesting note by C. H. Best and J. H. Ridout of Toronto on choline, which acts in the diet to inhibit the accumulation of neutral fat and cholesterol esters in, and accelerates their disappearance from, the liver.

Reference has only been made to half the reviews ; it must suffice to show how much work is going on and how valuable these reports are. Messrs. Murray Luck and James Smith have once more earned the thanks of their biochemical colleagues.

PROTECTION OF THE RADIATION WORKER*

By Dr. G. W. C. Kaye, O.B.E., F.R.S.
National Physical Laboratory

THE basic ideas of protection for radiation workers by the use of remoteness and absorptive shielding are obvious enough: the remarkable thing is the time it took to secure their observance. Naturally, the X-ray tube as evolved by Röntgen and his contemporaries in 1895 onwards was entirely unprotected, but although the explanation was not clear, the dangers of superficial injuries through indiscriminate exposure to the rays had become evident within a few months of their discovery. There were those who attributed the injuries to personal idiosyncrasy, electrical effects, ultra-violet rays, platinum particles from the X-ray tubes, platinocyanides from the fluorescent screens, etc. Among other things, red silk and thin rubber sheet were actually advocated as preventives! Röntgen himself probably escaped hurt for the reason that he conducted his experiments, which were mainly photographic, with the X-ray tubes inside a metal box.

In 1898, a committee appointed by the Röntgen Society collected evidence, much of it confusing, on the harmful effects of the rays. Presently, the principle of absorptive shielding began to emerge, and a distinction was drawn between the effects of 'hard' and 'soft' X-rays. But developments were slow, and so it happened that for many years, protection for most workers continued to be rudimentary or nearly non-existent and, whether owing to apathy or ignorance, injuries and deaths continued to result. The position was aggravated during the War of 1914–18, for many of the X-ray diagnostic sets on which the British army depended were of relatively primitive design. Such outfits, which wholly employed induction coils and gas tubes, were necessarily of restricted output, and exposures, particularly in screen examinations, were often formidable.

BRITISH RECOMMENDATIONS

A series of casualties to a number of prominent X-ray workers during the next few years definitely aroused public opinion. It had become apparent that in addition to general deterioration of health, the signal effects were of three main types: (*a*) injuries to the superficial tissues (usually of the hands) which, with neglect, might become ulcerated or even cancerous; (*b*) prejudicial changes in the blood which might progress to fatal anæmia; and (*c*) derangements of internal organs. More effective protection for the X-ray worker was clearly necessary; but no less important to the X-ray worker was the absolute safeguarding of the patient against accidental over-exposure, particularly in screening and therapy. In 1921 the British X-ray and Radium Protection Committee was formed under the chairmanship of Sir Humphry Rolleston, the members being nominated by various radiological and scientific bodies. It speedily got out a series of protective recommendations which, incidentally, were the first of the kind to be issued by any country, so giving a lead to the world in these matters. These recommendations took cognizance of three primary dangers: (*a*) undue exposure to radiation; (*b*) high-voltage risks from exposed conductors; (*c*) undue exposure to toxic gases produced by coronal discharge. Since 1921, the Committee has revised the recommendations on a number of occasions. In the light of greater knowledge and experience, the recommendations gained in precision and detail, and presently extended their scope to include film storage, electro-medical apparatus and ultra-violet therapy.

The attention of the younger workers may be directed to the difficulties with which the British Committee was confronted in its first efforts to specify and standardize protective measures. The need was great, for the conditions in the majority of X-ray departments were thoroughly unsatisfactory in those days. The Committee realized the pitfalls of a biological unit of dosage, but a bigger obstacle was the absence of an accepted physical unit of quantity of radiation. Only a few workers had attempted to make or utilize physical measurements which could be looked upon as significant or trustworthy; and the best the Committee could do was to try to translate into specific recommendations a sort of grand average of the protective measures which could be gleaned from the working conditions of a number of experienced radiologists who had escaped injury and still enjoyed normal health. A committee which attempts to put forward safety recommendations must err, if it errs at all, on the side of caution, and it was perhaps not surprising that at the first onset the recommendations were regarded by some as unnecessarily drastic, and that the embryonic efforts of the British industry, which backed the Committee's work loyally and wholeheartedly, to provide adequate protection against stray radiation, was deprecated in some quarters as heavy, clumsy and costly, and too cramping for the work of the radiologist. But presently the heavy lead-protected boxes and the like departed in favour of the self-protected X-ray tube in which the full degree of lead protection laid down by the Committee was incorporated in the tube itself, and so made it possible with lighter weight and better mechanical designs to restore the freedom of action to which the radiologist was accustomed.

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* Substance of the fourth Stanley Melville Memorial Lecture delivered before the Society of Radiographers on February 10.

Looking backward, it is scarcely possible to over-estimate the progressively beneficial influence of the Committee's recommendations on the well-being of the radiation worker, whether in hospitals or industrial and research establishments, as well as on the development and design of X-ray equipment. The Ministry of Health and the Ministry of Pensions gave the recommendations their support, and the National Physical Laboratory collaborated by inspecting some hundreds of hospitals and equipment from the point of view of the recommendations. Furthermore, thanks chiefly to the activities of an Inter-Services Advisory X-ray Committee, which has functioned since 1926, the three British defence services entered the present war with X-ray departments and equipment of which the general standards of safety conform to the Protection Committee's requirements as fully as those of civilian hospitals.

INTERNATIONAL RECOMMENDATIONS

In 1928, at the second International Congress of Radiology at Stockholm, the British Committee submitted proposals based on the British recommendations as a basis for international agreement, the outcome being that they were adopted as international recommendations. An International Protection Commission was also formed with representatives from Great Britain, United States, France, Germany, Italy and Sweden, Dr. Melville and Dr. Kaye being elected secretaries. These recommendations have been revised triennially by the Protection Commission on the occasions of the successive international congresses held in Paris, Zurich and Chicago, and would no doubt have come up again in Berlin this year under happier conditions. Meanwhile, the international recommendations have been adopted in principle throughout virtually the civilized world. They have been implemented by more detailed national recommendations drawn up by protection or safety committees in a number of countries.

X-RAY PROTECTION

From the first, the British recommendations stressed the obvious value to both operator and patient of enveloping an X-ray tube as completely as may be with protective material of a thickness adequate for the X-ray voltage concerned. Such thickness is almost invariably stated in terms of lead, since this is the most effective and convenient absorbent readily available at a reasonable cost. The recommended thicknesses gained in precision as two major steps in progress came about. The first step was the adoption at the Stockholm International Congress of the international röntgen as the unit of quantity of X-radiation, based on an air-ionization method of measurement under specified conditions. The second step was the adoption by the International Protection Commission of a maximum 'tolerance dose' of X-rays. While there are a number of uncertain variables which do not lie within the province of physics but are wholly biological, the erythema dose is commonly accepted on broad grounds as an index of biological response for the average individual, the tolerance dose being taken as 1/1,000 of an erythema dose in three working days, under conditions when the whole body is irradiated. Estimates of the X-ray erythema dose depend on the exciting voltage, but, on the average, evaluate it as equivalent to about 600 röntgens (r.), so that the tolerance dose corresponds to 0·2 röntgen in a normal working day of 7 or 8 hours, or 1 röntgen per working week of 5 days, or 10^{-5} röntgen per second. The protective lead thicknesses for primary X-ray beams which are given up to 600 kv. in the latest International and British recommendations are in general harmony with this tolerance figure under average conditions, corresponding in actual fact to an initial dosage rate of about 2 röntgens per minute at the point to be shielded.

When an X-ray equipment is tested, stray radiation may be evaluated either by a convenient form of dose meter or a Geiger counter, or by carrying on the person a portable ionization chamber of small capacity, or a photographic film. In point of fact, such a film test is very sensitive, blackening which is 'just clearly visible' corresponding (with standard development) to about 0·01–0·02 röntgen (that is, about 1/20–1/10 of the daily tolerance dose), in the case of X-rays of qualities associated with, say, 100–200 kv. The corresponding figure for gamma-rays is about 0·1 röntgen (that is, about one half of the daily tolerance dose).

As regards the protection for X-rays from higher voltages, Mr. W. Binks and I have recently shown, on the basis of theoretical and practical data relating to photo-electric, scattering and nuclear

Exciting voltage (pulsating)	Total lead protection required to give the tolerance dosage rate of 10^{-5} r./sec. at 1 metre distance with 1 milliamp. tube-current (X-rays emitted perpendicular to electron beam)	
	Calculated values (Kaye and Binks)	Experimental measurements (Bouwers and van der Tuuk)
400 kv.	18 mm. lead	17 mm. lead
600	40	36
800	60	57
1000	80	79
2000	175	—
5000	290	—

absorption processes, that it is possible to forecast the appropriate protective lead shielding for any voltage. We have somewhat prophetically extended our calculations up to 5,000 kv., though, in practice, 2,000 kv. is roughly the highest voltage at which X-rays have so far been generated. The validity of the calculations, at any rate up to 1,000 kv., is supported by the good agreement with some experimental results since published by Bouwers and van der Tuuk. This is shown in the accompanying table, where it will be noted that the lead protection required for 1 million-volt X-rays is about 3 inches, for 2 million-volt rays 7 inches, and for 5 million-volt rays nearly a foot.

Incidentally, if we may, not unfairly, regard the X-radiation from a 2-million volt tube as comparable in quality with gamma-rays, then at 1 metre distance from such a tube operating at constant potential, the maximum X-ray output, which is of the order of 210 röntgens per minute, corresponds to the gamma-ray emission at a like distance from 16,000 grams of radium, a figure the magnitude of which may be contrasted with the total of 1,000 grams known to be isolated in the world.

RADIUM PROTECTION

The problems which present themselves in protecting radium workers are more acute and troublesome than with X-rays. A knowledge of the radium contents of radium sources is naturally of service in this connexion. Such measurements were first put on a satisfactory footing when, following the formation at Brussels in 1910 of an International Radium Standards Committee with the late Lord Rutherford as chairman, an International Radium Standard was set up in Paris in 1913, thanks to the skill of the late Mme. Curie and the generosity of the late Sir George Beilby. In the same year, the latter also presented to the National Physical Laboratory the British National Radium Standard, which had been calibrated in terms of the International Standard, and which has since formed the basis of test of nearly 200 grams of radium.

Protection from alpha- and beta-radiations (which are virtually all absorbed in the skin) is fairly readily achieved in the case of most forms of radium manipulation. As regards gamma-radiation, the position is less satisfactory than with X-rays. Progress came when the Fifth International Congress of Radiology in 1937 accepted the röntgen as a unit for measuring gamma-rays as well as X-rays. Furthermore, the International and British Protection Committees were led tentatively to assume, on the evidence available, that the human body is equally susceptible to X-rays and gamma-rays, and adopted the same tolerance dose for both radiations, namely, an average dose over the whole body of 1 röntgen per working week. There is, however, some divergence of opinion on this point, certain workers maintaining that the tolerance dose should be smaller for gamma-rays.

It should be noted that X-ray protective lead values do not apply to gamma-rays, materials lighter than lead being normally more effective against gamma-rays than X-rays. The protective thicknesses for gamma-rays may be estimated sufficiently accurately by assuming that the absorption is proportional to the density. Thus, the introduction of tungsten alloys, with a density half as much again as that of lead, has resulted in smaller and more compact radium 'bombs' without sacrifice of protection. Incidentally, the 'safe working distances' for radium bombs, calculated from the tolerance dose, are less than is often imagined; for example, the safe distance for 1 gram of completely unprotected radium is no more than 5 yards, which is reduced to 1 yard or so by enclosure in a lead bomb with 5 cm. walls. By the same token, there is no necessity, apart from questions of air raids, to locate properly designed and protected radium safes at extravagantly large distances from the personnel.

ELECTRICAL PRECAUTIONS

The practice in the pioneer days of Geissler discharge tubes, of using thin copper wire, unprotected except by silk or cotton covering, to connect the high-tension poles of induction coils or electrical machines to the terminals of discharge tubes, was a legacy which persisted with gas X-ray tubes for many years, for although an unexpected electric shock for the personnel was definitely unpleasant, nothing more serious was likely to follow. Many will recall the slack or dangling high-tension leads which carried, usually in the dark, currents at many thousands of volts, sometimes only a matter of inches from the patient or attendant. Heavier high-tension leads followed in due course, but with the advent of larger coils, and particularly of high-tension transformers, with or without condensers, the power developed was such that greater caution was necessary, and, indeed, fatal accidents began to occur.

The present-day solutions for shock-proofing X-ray outfits take two major forms. One is the shock-proof X-ray tube combined with high-tension cable which, provided with heavy rubber insulation and earthed metallic sheathing, is both shock-proof and sufficiently flexible not to restrict mobility unduly. The other is the complete enclosing of X-ray tube and high-tension transformer in a common earthed metal container filled with a dielectric such as transformer oil or, more recently, 'freon'.

VENTILATION AND LIGHTING

Nowadays there are no two opinions about the Protection Committee's advocacy of light schemes of decoration for all rooms (including photographic dark rooms), together with large windows affording good natural lighting and admitting sunshine and fresh air whenever the rooms are not in use. A bigger step was the introduction of artificial ventilation into X-ray departments. The importance to the operator of generous ventilation is now recognized as second only to that of protection, particularly where apparatus is not corona-free, or the control room is not completely isolated from the treatment room. In some countries, notably the United States, elaborate schemes of air-conditioning are employed.

Mention should here be made of the importance of directional ventilation in preventing the inhaling of radioactive dust or radon during the prolonged manipulation of unsealed radium salt, radium ore, etc. ; cases of radium poisoning have occurred for lack of such precautions.

Finally, this is perhaps the most convenient place to make passing reference to the manner in which the problem of fires associated with film storage was solved by the introduction of non-inflammable cellulose acetate film, in place of the highly inflammable nitrate film.

NEUTRON PROTECTION

The problem of protection for the worker with neutrons seems likely to have a wider interest before long, in view of the invention of the cyclotron by Lawrence and the immense yield of neutrons which can be so obtained. It would appear from recent researches that neutrons can be measured directly in röntgens with reasonable accuracy, and that the biological activity of neutrons may be up to eighty times that of X- or gamma-rays, being probably dependent on the cell structure. In the interests of safety, therefore, it seems well to assume at present that the tolerance dosage rate for neutrons is of the order of 1/100 of that for X- and gamma-rays, that is, about 10^{-7} r./sec.

As regards the protection of personnel against neutrons, the task would be the easier if human tissue were not so effective in absorbing neutrons. Whereas in the case of X- and gamma-rays, the light elements present in tissue are only slightly absorptive, these same elements (or at any rate, the hydrogen) have properties the very reverse where neutrons are concerned. On the other hand, hydrogen-bearing materials such as water or paraffin, if placed around a neutron source, can be turned to account in slowing down and partially absorbing the neutrons before they reach the personnel. In practice, tanks of water or paraffin 50–100 cm. across are used for screening purposes. About 50 cm. of paraffin reduces the total number of neutrons to about 1 per cent, while a few per cent of boric acid in water reduces the slow neutron activity to about one third of that produced by water alone. Having by such means achieved as much absorption of the neutrons as is practicable, further reliance is then placed, as with X- and gamma-rays, on remoteness of the personnel from the neutron source.

INTERNATIONAL MONUMENT TO X-RAY AND RADIUM MARTYRS

What I have tried to set down in this memorial lecture is largely intended for the younger generation who, equipped as they are, like any modern army, with adequate defensive measures, will, I hope, sometimes spare a thought for those X-ray pioneers who, undaunted by long and sometimes unbearable suffering, which drugs might utterly fail to relieve, and which was perhaps followed by mutilating operations or a cruel death, continued to apply themselves indefatigably to perfect the use of Röntgen's discovery for the benefit of humanity. Their martyrdom prepared the way which rendered the present use of X-rays free from danger.

Such matters have a world appeal, though it was in less troubled days that the German Röntgen Society erected in Hamburg a monument to the X-ray and radium martyrs of all nations. The monument, which was unveiled on April 4, 1936, takes the form of a simple rectangular column of sandstone surmounted by a laurel wreath. The names of radiologists, radiographers, physicists, chemists, laboratory workers and nurses whose deaths were due to work with X-rays and radium are engraved on the sides. The total is 169 names spread over fifteen different nations : though it is probable that the list is now by no means complete, nor does it attempt to take cognizance of the large number of less serious casualties.

FOOD PRODUCTION AND FOOD CONTROL*

By Sir John Boyd Orr, F.R.S.,
Rowett Research Institute, Aberdeen

IN anticipation of the War, the Foods (Defence) Plans Committee, working in co-operation with the trades concerned, prepared an elaborate scheme of food control for Great Britain. Excellent though this scheme is in some respects, it is not sufficient to deal with the situation. It does not take account of the fact that, even before the War began, the diet of the poorest third of the population was not up to the standard we now know to be necessary for health. This is the weakest part of the food front. Our food plans should be directed first and foremost to bring the diet of these people up to the standard. If they have sufficient, we need not worry about the rest of the population.

The present system of rationing and price fixing cannot bring about an equal sharing of the available food. Coupons have been issued for 4 oz. of butter and 4 oz. of bacon per week. Even in peace time, when prices were lower, many families could not afford to purchase these amounts. Consequently, we have people with coupons who cannot purchase the rationed amount because they have not the money, and people with plenty of money to purchase the additional amounts they want, but cannot get them because they have not the additional coupons. This fosters an illicit trade in coupons and food which defeats the object of rationing. If the illicit trade does not develop quickly enough, food remains unsold. As the price rises the amount unsold increases until it becomes necessary to increase the rationed amount, so that those with money can purchase more. It is impossible to have two systems, rationing by price and rationing by amount, operating in the same field without creating anomalies. If rationing is to be efficient and to apply to the whole population, the rationed amount must be within the purchasing power of everybody.

Nor does price fixing necessarily benefit the poor. Maximum prices tend to become the minimum. Some commodities have a wide range of prices. Pooling and price fixing will tend to raise the price of the cheapest qualities, which are those that the poor use. Then again, the poor get a less expensive distributive service than the well-to-do. Prices are likely to be fixed on the higher costs of the more expensive service, and the poor may be forced to pay for a service which they cannot afford and indeed will not get.

It is worth while reconsidering the food policy of Great Britain. We are only at the beginning of what may be a long, grim struggle. The issue will depend as much upon the powers of endurance and the morale of the civilian population as on the efficiency of the fighting forces. Next to having a cause worth fighting for and worth dying for, the most important factor for morale is food. In the War of 1914–18, we sustained serious reverses without any loss of spirit, but there was a grave danger of war-weariness in the food shortage of 1917. Our food policy should be designed to raise to the highest possible level national health and physical fitness, upon which morale and powers of endurance so largely depend. It must, therefore, be based upon nutritional needs.

We should first ascertain the total needs of the population, and then determine how these can best be met, keeping in view the possibilities of increasing home production and the need for using the minimum amount of shipping space and foreign exchange for food imports.

In the first place, we must provide more protective foods to bring consumption among the whole population up to the level among the well-to-do, which is about the level required for health. Then we must provide more energy-yielding foods to meet increased energy expenditure due to the War. Unemployed men and men in sedentary occupations need only about 2,500 calories per day. Many of these will be drawn into industry or the fighting forces. In the former case their needs will increase to between 3,000 and 3,500 calories, and in the latter case to about 4,000 calories. We must make provision for a total increase of probably between 10 and 20 per cent.

We are thus faced with the problem of increasing our total food supplies at a time when we must economize in shipping space and in foreign exchange; and if we plan to have the whole population adequately fed, we have the further problem of adjusting prices to purchasing power at a time when the cost of food is rising.

In normal times, about two thirds of the total food supplies of Great Britain are imported. Including feeding stuffs for animals, this takes nearly 20 million tons of shipping per annum. Home production must be increased to the utmost limit and the increase should consist of essential foods which are costly to import in terms of shipping space or foreign exchange. The potato should come first on the list. It is the most important crop in war. An acre of potatoes yields twice as much food as an acre of wheat, and it is the safest crop to take out of newly ploughed-up pastures. In the War of 1914–18, the yield of potatoes from old pastures averaged 7·1 tons per acre compared with a pre-War average of 6·2 tons on ordinary potato land. The potato is of special nutritive value; it is our main source of vitamin C. In Great Britain the average consumption is only about 9 oz. per head per day, though in some families it is as high as 23 oz. In Belgium the average consumption is 19 oz. and in Germany it is 16 oz. We could, with advantage to national health, increase consumption by at least 50 per cent.

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* The arguments of the present article are set forth at length, with additional data, in a booklet "Feeding the People in War-Time", to appear shortly (London: Macmillan and Co., Ltd.).

The allotment campaign will lead to an increased consumption of vegetables. It is estimated there are about 3½ million gardens in Great Britain, and the number of allotments is likely to be brought up to nearly 1½ million. Out of a total of between 10 and 12 million households in the country, there will thus be nearly 5 million wholly or partially self-supporting in vegetables. If our canning factories are running to full capacity in the summer and autumn, building up a store of preserved vegetables for winter use, and if the distribution of farm-grown vegetables be better organized to reduce the gulf between what the producer gets and the consumer pays, it should be possible to bring consumption of nearly the whole population up to about 6 oz. per head per day, the level among the well-to-do.

Milk is the most important protective food. There is already sufficient milk in Great Britain to bring consumption among the poor, at present less than a quarter of a pint per head per day, up to nearly two thirds of a pint. There should be no great difficulty in making milk, which is at present surplus to the liquid market, available on a cash and carry basis at a price within the reach of working-class families with children.

Milk, vegetables and potatoes between them contain all the food constituents necessary for health. If everybody has sufficient of these, there need be no malnutrition. If we have the right agricultural policy we can produce sufficient for the needs of the whole population, without reducing the pre-War output of other foods.

With sufficient of these three protective foods, we could, if we were forced by lack of shipping space or foreign exchange, limit imports to the cheap, easily carried, energy-yielding foods. The following table shows the estimated storage space, energy value, and price of some of the main foods we import.

The import policy of Great Britain is, of course, affected by trade and other considerations. Thus, for example, we shall import food from eastern Europe, not so much because we need it as to keep it out of the hands of the enemy. Considering only nutritional needs, however, priority in imports should be given to bread and fat, until we have a reserve which puts us beyond the danger of a shortage. In 1914–18 we tried to get a reserve of thirteen weeks' supply, but could not maintain it at that level. With the uncertainty of the present War, we should have at least a six months' reserve of wheat and fat. Of the other foods, sugar is the cheapest energy supplier in terms both of money and shipping space, and would probably be put next to wheat and fat in the list.

	Approx. shipping space (cu. ft. per ton)	Approx. energy value (1,000 cal. per cu. ft. shipping space)	Cost of 100,000 cal
Sugar ..	45	83	4*s*. 6*d*.
Wheat ..	50	56	5*s*. 6*d*.
Fats & tallow	80	118	8*s*. 6*d*.
Dried fruits ..	50	55	21*s*.
Cheese ..	60	56	39*s*.
Frozen beef ..	95	26	40*s*.
Eggs in shell ..	120	12	75*s*.

If we had sufficient of these energy-yielding foods, together with sufficient milk, vegetables and potatoes, we might be reduced to a spartan diet, but there would never be any need for us to capitulate owing to food shortage. A sufficient amount of the energy-yielding foods could be imported with less than a third of the pre-War shipping space devoted to food and feeding stuffs.

Though these three protective foods and three energy-yielding foods might well form the basis of a national dietary in war-time, it is not suggested that the diet of any part of the population should be reduced to these. Even if shipping space were reduced to a minimum, we would have, in addition to these, all the other foods we can produce at home, and it is exceedingly unlikely that the shipping position will ever be so bad that we cannot continue to import other foods.

The most difficult problem is not the maintaining of supplies to meet nutritional needs; it is, as it was in peace time, one of bringing a sufficient amount of the right kind of food within the purchasing power of working-class families with children. It has already been decided to subsidize food. It might be advisable to confine the subsidies to the absolutely essential foods and to make it sufficient to bring the price of these within the purchasing power of every family.

To provide for the different physiological needs and for different likes and dislikes, it would be necessary to leave a margin of money for the purchase of other foods. Thus, for example, if milk, vegetables and potatoes, bread, fat (butter or margarine) and sugar are chosen as the essential foods to be subsidized, and, if it were found that, say 4*s*. 6*d*. a week was the amount available for food among the poorest 10 per cent of the population, the price of these basic foods should be fixed so that a sufficient amount of them can be bought for, say, 3*s*., leaving 1*s*. 6*d*. for the purchase of other foods, such as beef, mutton, fish, fruit, and tea and other beverages.

With such a policy it is doubtful whether it would be worth while maintaining a costly and elaborate organization for the detailed control of food. The Government is the wholesale purchaser. It can fix wholesale prices at a level estimated to have the retail price within the purchasing power of everybody. If the wholesale prices are known and wholesale distribution equitable, competition between merchants and shopkeepers, who are dependent upon the goodwill of their customers, will probably be sufficient to prevent any profiteering. Indeed, it has never been suggested that there was any gross profiteering amongst shopkeepers. Speculation and profiteering, in so far as it existed at all, was in large wholesale dealing, which is now under Government control.

The policy would provide a flexible system for adjusting the national dietary to what we can afford in money or in shipping space. The few essential foods chosen to be subsidized and to be provided in such abundance as there would be no need for rationing, would be regarded as the rock-bottom diet below which we cannot go with safety. Consumption of the other foods could be controlled by price. If we wish to economize in shipping and foreign exchange, we can limit consumption by increasing the price. On the other hand, if supplies of some other foods were sufficient, they could be added to the list of 'essential' subsidized foods and so brought within the reach of everybody. It is most probable that at the present time some other foods such as cheese and dried fruits could be added to the list. If the Government controls the wholesale trade, which is the bottle neck of our food supply, it can regulate consumption as seems desirable by regulating wholesale prices.

In the same way, home production can be regulated by price. The farmer produces for profit. He increases or decreases his output of different foods according to the price he thinks he will get. The farmer should be given a guaranteed minimum price calculated to call forth the additional food we need. The guaranteed prices of the different foods should be adjusted to each other in such proportion that the foods would be produced in the proportion we want. The control of production by the regulation of the price offered would enable farmers to devote their land to the crops for which they are most suited. This would utilize the land of Great Britain to better advantage and give a greater increase in production than a system of compulsory ploughing-up according to a fixed ratio, without any guidance as to what additional foods should be grown.

THE SEVERE WINTER OF 1939-40

THE frost which began on December 27, 1939, and continued with few intermissions until about February 18, 1940, was the most severe in Great Britain since 1895. December 1939 was cold on the whole, the average temperature of 37·8° F. at Kew being nearly 4° F. below the normal; but apart from a short spell of frost about December 22 it did not approach in severity the latter part of the winter. At the end of the month the minimum at Kew fell to 19° F., but comparatively mild conditions returned during the first week in January. The main period of frost came between January 10 and 24, when the mean temperature at Kew was continuously below freezing except for January 12 and fell to 22° F. on January 20. Some very low minima were recorded in all parts of England and Scotland: – 5° F. in the screen at Dalwhinnie, – 6° F. at Bodiam in south-east England and Ambleside in the north-west, and – 10° F. at Rhayader, all between January 17 and 21. At Greenwich the lowest minimum was 12° F., identical with the lowest minimum there in February 1929 and 5° higher than in February 1895. After a short break the month ended with another cold spell, and the mean temperature at Kew was as low as 31·3° F., compared with a normal of 40·5°. February began cold, but severe weather was not encountered until February 10, when another week of frost began, with very low temperatures about February 14.

There was not a great deal of snow in Britain, except in the north, but an even more disastrous phenomenon, glazed frost, occurred over the South and West of England on January 27–28. All through the Saturday night and most of Sunday, fine rain fell through a layer of air which was just below 32° F. The raindrops were cooled below freezing point, but remained liquid until they struck the ground or exposed objects, when they froze instantly into hard clear ice. Twigs and branches of trees, telephone wires and railway tracks were coated several inches thick; one length of telegraph wire in Gloucestershire carried a cylinder of ice 2·4 in. in diameter, and weighing

130 times as much as the wire alone. Mr. C. J. P. Cave calculated that in Hampshire there was a weight of 85–90 lb. of ice on a single wire between adjacent posts. Under the strain, wires and posts gave way, blocking roads and disorganizing the telephone service. Trees were split or brought down by the weight of ice on their branches, and added to the confusion, while the frozen road and rail surfaces caused an almost complete breakdown of transport. The weather continued very cold, and it was some days before conditions approached normal; there was even a second, though less severe, glazed frost on the morning of February 3.

The difference of eleven years between 1929 and 1940 at once suggests the influence of the sunspot cycle, especially when it is remembered that February 1917 also produced a severe frost, while that of 1895 came 22–23 years earlier. All these occurred about one year after a sunspot maximum. There was, however, no similar frost in 1906 or 1907 and the eleven-year recurrence is completely absent before 1895, so that the succession 1917–1929–1940 must be regarded as most probably a coincidence. D. Brunt, in his study "Periodicities in European Weather" (*Phil. Trans. Roy. Soc., Lond.*, A, 225, 247–302), finds no trace of a periodicity of eleven years in the temperatures of London, Stockholm, Paris or Vienna. The cycle of eleven years is the largest periodic element in the temperature of Edinburgh, and shows a minimum about 1938–39; but the double sunspot cycle of 22–23 years is almost equally prominent and is now near its maximum. For London this 22–23 year cycle is the largest component and is likewise near its maximum. In any event the amplitude of these periodic terms is small in comparison with the departures from normal temperature during a severe winter.

The other well-known cycle, Brückner's of thirty-five years, also fails to appear in Brunt's tables for London and Edinburgh, though he found it at Paris and Berlin. It happens that the interval between the last two great frosts, 1895 and 1929, was thirty-four years, but the Brückner cycle is of no help on this occasion, for the winter of 1904–5 was not particularly cold. Nor was 1840, in spite of the supposed grand cycle of a hundred years. Cycles are useless for forecasting severe winters.

On the other hand, although really severe winters may come at irregular intervals, they do present a considerable regularity in the course of events which constitutes them. The greatest intensity of cold rarely occurs until some time in January and quite frequently not until February, and in Great Britain it tends to come in waves of ten or fifteen days separated by brief intervals of milder weather. In a prolonged severe winter, central Europe is occupied by a persistent stream of very cold air coming from the east and north-east, with a temperature sometimes many degrees below 0° F., but over the Atlantic the normal south-westerly winds still prevail. For most of the time the cold winds succeed in crossing the North Sea or English Channel, though sometimes by devious routes, but now and again they give place to the mild south-westerlies. Even the brief passage over the North Sea warms the cold air appreciably, and temperatures in Britain do not fall so low as those on the Continent. Minimum temperatures are not yet available; but at 7h., temperatures only a degree or two above 0° F. were recorded at Copenhagen on January 17 and at Paris on January 23–25. Farther east much lower figures were recorded, down to − 26° F. at Dorpat on January 17. The whole period from about January 1 until January 25 appears to have been generally cold in Europe.

Another cold wave began about February 9, and on February 12, when Copenhagen recorded − 4° F. at 7h., the Baltic between Denmark and Sweden was firmly frozen and, according to reports in the Press, was crossed on foot for the first time in centuries.

OBITUARIES

Colonel R. E. B. Crompton, C.B., F.R.S.

WE deeply regret to record the death on February 15 at ninety-four years of age of Colonel R. E. B. Crompton. He was one of the greatest pioneers both in mechanical road traction and in electrical engineering.

Rookes Evelyn Bell Crompton was born at Sion Hill, Yorkshire, on May 31, 1845. In 1871, he married Elizabeth Gertrude, daughter of George Clarke of Tanfield House, Ripon, and had two sons and three daughters. He was educated at Harrow and served as a naval cadet in the Crimean War (medal and Sebastopol clasp); in the Rifle Brigade (1864–76); in South Africa, 1900 (despatches, Queen's medal with three clasps, C.B.). He was founder of Crompton and Co.; twice president of the Institution of Electrical Engineers; president of the Institution of Automobile Engineers; founder member of the Royal Automobile Club.

Colonel Crompton had a most varied and interesting life and career, and had numerous friends all over the world. Luckily for us, in 1928 he wrote a volume of "Reminiscences" which he dedicated to his wife; "during almost sixty years my courageous fellow-worker and devoted companion". She died on November 27 last, to the great grief of her husband. They had nearly reached the seventieth anniversary of their wedding day.

The Hon. Sir Arthur Stanley, treasurer of St. Thomas's Hospital, London, in an introduction he wrote to Crompton's "Reminiscences", says: "to write the preface to an autobiography is never a very easy task, but when it is the self-told life story of a man of 83, every minute of which has been made to do the work of two, the task becomes well-nigh impossible". One who remembered Lord Alvanley, the celebrated wit, and could speak of the Great Exhibition in Hyde Park as if it were a thing of yesterday, who was a cadet in the Royal Navy at the age of eleven; who, at that early age, went out and received the Crimean War Medal and Sebastopol clasp before reaching the age of twelve, was undoubtedly making a remarkable beginning to a wonderful career.

Then comes a period which is similar to the ordinary life of a lively English boy. When Crompton returned to England he left the Navy, and towards the end of 1856 was sent to school at Elstree to prepare for Harrow. He left Harrow in 1860 and entered the Rifle Brigade three years later. He went to India in the following year, and after serving for a time with his regiment was seconded for special service as superintendent of the Government Steam Train Department. In 1865, when the summer was exceptionally hot, he caught a particularly noxious form of malaria, which troubled him intermittently for many years. He was sent by his doctors to the Murree Hills to convalesce, and made friends with several great sportsmen.

Shortly after this, Crompton received a staff appointment at the Umballa Durbar, and got into touch with several influential men at headquarters. He was invited by the commander-in-chief to the aides-de-camp quarters at Simla, and he was successful in interesting them in his project of substituting mechanical transport for the bullock trains which at that time were generally employed for army purposes. He was appointed an extra aide-de-camp to the commander-in-chief, and in this capacity was often asked to accompany Lord Mayo, the Viceroy, on his rides. His own road engine (the *Blue Bell*), which he had practically completed before he left for India and which travelled at an average speed of four miles per hour, had been left in the hands of R. W. Thomson of Edinburgh, to develop. Through the good services of the Director-General of the Post Office, who controlled the bullock train service in India, the first *Blue Bell* 6 h.p. road vehicle was ordered and Crompton received the official appointment as "Superintendent of the Government Steam Train", so as to take charge of the experiments. He was temporarily withdrawn from the army in order that this could be done. After many difficulties and adventures with the *Blue Bell* in India, his return to London was of an unusual kind, as the Franco-Prussian War was on and Paris was invested. Eventually the German military authorities gave them permission to proceed, provided they put on uniforms and wore their swords to show that they were officers.

At this time, mechanical road transport in England was limited to the agricultural traction engines, which were allowed, as a favour, to clank along the high roads at the speed of the man who walked in front with a red flag, and even at those low speeds their hauling capacity was very poor. Thomson, by his invention of rubber tyres of great cross-section which flattened themselves under the weight of the engine, at once doubled the hauling power and allowed his engines to be run at speeds up to ten miles an hour whenever the Red Flag Act permitted it.

From 1878 until 1882, Crompton carried on a business as an electrical manufacturer, confining himself to the manufacture of electrical arc plant. The firm sold and installed Gramme generators and Bürgin dynamo machines, for the latter of which it acquired the sole right of manufacture. These machines could supply from six to eight arc lamps in series, and so the firm could undertake the lighting of railway stations, goods yards, docks and other open places in which work has to be carried on at night; and for such purposes the firm found a ready market. An order to light St. Enoch Station, Glasgow, with arc lamps was obtained, and the interest taken in this work by Sir William Thomson (Lord Kelvin) cemented a friendship between them which was helpful to both.

Willans the engine-builder, about this time (1879–1880), was a frequent visitor at Crompton's house in Porchester Gardens. They were both interested in electrical development and were able to discuss together and help one another in their respective difficulties. They agreed that the generator sets of the future must consist of a high-speed engine coupled direct to a direct current dynamo. During 1879, Cromptons designed many portable sets of electric lighting plant. Combined with this set, the first Willans high-speed compound engine gave such remarkably economical results that it attracted great attention from the engineering world. About Christmas, 1879, Crompton lighted up his own house in Porchester Gardens. At first he used primary cells, but they were not a success, so he brought in one of his portable sets into the mews at the back of his house and gave special parties, using small arc lights fixed in his drawing-room and dining-room. This was probably the first instance of effective electric lighting in a private house, although there had previously been exhibitions of arc lighting at the Royal Institution and elsewhere.

Early in the year 1880, a messenger from Messrs. Mawson and Swan, the well-known chemists of Newcastle, to whom Crompton had supplied arc lighting plant, called on him to say that Mr. Swan urgently desired to see him. He went to Newcastle, where Swan took him to his laboratory and showed him twenty small incandescent lamps, which burned very brightly and steadily, each having a carbon filament enclosed in a globe, exhausted to a very perfect vacuum, and claimed that he had solved the problem of electric light for internal illumination. Crompton agreed with him. Later in the same year (1881), the great German physicist Helmholtz lectured at University College, London, and for the illustration of his experimental work Crompton supplied him with one of his portable sets of generating plant. For the International Exposition of Electric Lighting held in Paris in the summer and autumn of 1881 in the Palais de l'Industrie, Cromptons sent over a fine exhibit, and were awarded the first gold medal ever given for electric lighting plant.

The great fire which in 1883 destroyed the Ring Theatre of Vienna with great loss of life so impressed on the Emperor Francis Joseph the dangers of gas that he asked the Imperial and Continental Gas Company, which then supplied gas for the lighting of Vienna, whether it could not arrange for the lighting of the Opera House and the other Imperial theatres by electricity as being a safer and better illuminant. The Gas Company, advised by Prof. Monnier of the École Centrale in Paris, suggested that Crompton should be called in for consultation, and so in June 1885 he went with Prof. Monnier to Vienna and spent some weeks in considering the Emperor's question. At this time a small central station had been started in Berlin in the Friedrichstrasse. In London, the original Edison Company had done the same at a point near the Holborn Viaduct, and the Grosvenor Gallery scheme was in its initial stage. At this time the Swan Company had succeeded in turning out satisfactorily 100-volt lamps. At Vienna the company designed from its central station in the Schenkenstrasse 440-volt generators and laid twin conductors to carry this pressure up to the Opera House. Babcock and Wilcox boilers were some of those used. Part of the Vienna plant was delivered in the spring of 1886, and when more plant was required, Crompton went to Witcowitz in Moravia to give instructions for the boiler work.

The old Emperor Francis Joseph showed great interest in the electrical work when in progress, and very frequently came to watch the workmen, generally accompanied by his son, the Crown Prince. He paid Crompton the high compliment of saying that he wished his son Rudolph to be a good deal with them as a sort of pupil.

As soon as new scenic effects were made possible by electric lighting, Crompton had to spend a good deal of his time on the stage of the Grand Opera. This threw him into the society of Richter, who had already made his name as the great conductor of opera in London and was then endeavouring to reconcile old-time opera with the Wagnerism that was then just commencing. At that time there were two directors of the Grand Opera, Richter, who stood rather for the old school, and Jahn, who was all for Wagner and the Wagner school. They used to have great arguments and ask Crompton for his opinion on musical points. Crompton disclaimed all pretence of being an authority on music, although his mother had known Mendelssohn well at the time of his apogee and was acquainted with very many of the musical world at that time.

In 1896, Dr. John Hopkinson, who had succeeded Colonel Crompton as president of the Institution of Electrical Engineers, discussed the possibility of forming a corps of electrical engineers. This was accepted by the War Office, and Hopkinson took command with the rank of major in the Royal Engineers, Crompton being the senior captain. Four or five men well known in the electrical profession, including Hopkinson's eldest son Bertie, also joined the corps as officers. After training at Alum Bay in the Isle of Wight, Dr. Hopkinson left the corps to join his family in Switzerland. But a few weeks later the sad news arrived that he and two members of his family had been killed when climbing on the Alps, and so the whole work of training and organization of the corps fell on Crompton's shoulders.

Throughout the years which followed his return from the Boer War until 1914, Crompton never ceased from his efforts to persuade the War Office to interest itself in the introduction of mechanical transport, not only for war material, but also for the haulage into position of guns of greater power than had been hitherto used.

In an epilogue to his book of reminiscences Crompton says, quoting from an address he delivered to the borough authorities of Chelmsford in 1900, at the time when that town received its first cheap electrical supply:

"England in future, instead of being spoilt by densely populated industrial centres, might be covered with cottages extending for miles over the present almost uninhabited rural districts, so that the population would be more evenly spread over the kingdom. The factory hands, instead of having to work under the shafting in factories, should be able by the electrical transmission of power to carry on industrial pursuits in their own cottage homes. That is the future which lies before electrical engineers if they have the pluck and energy to force their views upon the public to a sufficient extent. The thing has been done in Switzerland, in Sweden and elsewhere on the Continent, and if I can live to see it accomplished in our own country, I shall be proud to have contributed in some degree to the solution of all the greatest problems of distribution."

ALEXANDER RUSSELL.

Prof. Ludwig Hopf

THE death of Prof. Ludwig Hopf occurred on December 21 at Dublin, only a few months after he had been appointed lecturer in applied mathematics at Trinity College, Dublin. Dr. Hopf went as a refugee to Cambridge in April 1939, after having lost his position as professor of applied mathematics at the Technische Hochschule, Aachen, on racial grounds soon after the Nazis came into power. He had been on the staff of the Hochschule since 1914 and had become one of its most popular teachers.

As one of the first pupils of Sommerfeld at Munich, Hopf graduated in 1909 with a thesis on the problem of turbulent flow in a river. He worked in particular on the influence of the roughness of the walls of a canal on the transition from laminary to turbulent flow. This work brought him into contact with the Mittlere Isar water regulation and drainage scheme, to which he was scientific adviser for several years. During the War of 1914–18, Hopf did valuable work on problems of stability of aeroplanes, and his collaboration with R. Fuchs led to their well-known monograph on aerodynamics. In the second edition (1934) the book was divided into three volumes, Hopf being responsible for the first, which dealt with general principles. This is still being used as the chief text-book for aeroplane designers in Germany.

In the early days of relativity and of quantum theory, Hopf collaborated with Einstein (1910–11). Several papers on radiation dating from that time, and a recent well-written popular account of matter and radiation (Springer, 1936) bear witness to his interest in this subject. More recently, Hopf studied the methods of solving linear differential equations in separate domains with the view of finding the relation between the corresponding solutions. A first paper appeared in 1935, and important applications to physical problems were to follow. The many friends of this genial and kind-hearted mathematician will deeply regret the loss they have suffered.

Prince Ginori-Conti

When Prince Piero Ginori-Conti died on December 9, Italy lost one of her most energetic industrial personalities and international science a devoted supporter. His name will always be associated with the industrial utilization of the volcanic springs in the Lardarello district of Tuscany. Thanks to his 'drive' and business acumen, these waters were made to generate electric current for transmission to Florence and Pisa, and to yield boric acid, carbon dioxide, etc., for industrial use. In the chemical works connected with this great undertaking, he was much helped by Prof. R. Nasini, and on the engineering side his son, Dr. Giovanni, one of the three children by his first wife, was of great assistance. An article on the Lardarello development appeared in NATURE of January 14, 1928, p. 59.

Ginori-Conti was born in 1865 as a scion of two ancient Italian families, Ginori and Conti, and on the latter side he claimed relationship with the Scottish Mackenzies. His title of Prince of Trevignano was inherited; that of Senator was granted him later in life. His first wife was the daughter of the Count of Lardarel, the owner of the springs, and his second wife was a French lady. A charming personality, Prince Ginori-Conti came frequently to London where, as a member of the executive committee of the Union Internationale de la Chimie, and as an honorary member of the Society of Chemical Industry, his visits were much appreciated by numerous friends.

Prof. Alexandru Slatineanu

Prof. Alexandru Slatineanu, a leading Rumanian bacteriologist and hygienist, who died on November 27, 1939, was born at Bucharest on January 5, 1873. He studied medicine in Paris under Berger, Dejerine, Babinski and Metchnikoff, in whose laboratory at the Pasteur Institute he made the acquaintance of his compatriot Prof. Cantacuzène, with whom he was closely associated henceforth. He qualified in 1901 with a thesis on experimental *Bacillus pfeiffer septicœmia*, for which he received the university medal awarded for theses of outstanding merit.

From 1902 until 1912, when he was appointed professor of bacteriology at Jassy, Slatineanu acted as chief assistant to Cantacuzène at Bucharest in his work on experimental medicine and the reorganization of the Rumanian health services. At Jassy he founded an institute of hygiene of which he was made director, and also organized an isolation hospital for infectious diseases. In 1917 he took an active part in the campaign against typhus fever which was then very prevalent in Moldavia. In 1931 he was appointed general secretary of the Rumanian Ministry of Health under Prof. Cantacuzène, who was the minister of that office. He was the author of numerous articles on infectious diseases which were published in French in the *Comptes rendus de la Société de Biologie, Bulletin de la Société de Pathologie Exotique, Archives roumains de Pathologie*, or in Rumanian in the *Revista Stintelor Medicale*.

J. D. Rolleston.

Dr. E. M. Mikkola

Dr. Erkki Mikael Mikkola, geologist of the Geological Commission of Finland, was killed at Taipale on February 13. Mikkola, who was born in 1907, had become a leading authority in Pre-Cambrian geology, possessing an intuitive faculty of seeing through a geological formation, and picturing it correctly in space and time. His scientific studies led him from botany to geography, quaternary geology, tectonics and petrology. His three Lapland maps are given a foremost place among Pre-Cambrian sheets of the Finnish Geological Survey. Their description in English is a monograph of fundamental value.

When the Russian attack developed on November 30, Mikkola, as a lieutenant in the reserve, went to join his company, leaving the Geological Survey at Helsinki just one hour before it was destroyed during a bombing raid. Thereafter he spent all his time, two and a half months, in the front lines, taking a full share in the dangers of the heroic defence.

We regret to announce the following deaths:

Prof. C. D. Marx, emeritus professor of civil engineering in Stanford University, on December 31, aged eighty-two years.

Mr. H. C. Newton, first chairman of Messrs. Newton and Wright, Ltd., London, manufacturers of X-ray equipment, on February 19, aged eighty years.

NEWS AND VIEWS

Lord Halifax and International Affairs

MANY speeches dealing with the present crisis have been made since the War began six months ago. That of Lord Halifax at Oxford on February 27 surpassed them all not only in the clarity with which the fundamental issues at stake were set forth, but also in the eloquent and moving enunciation of their relation to a philosophy of life which looks beyond the individual ideal to an aim worthy of the pursuit of mankind at large. Addressing his audience, as he said, with the dual personality of Chancellor of the University and H.M. Secretary of State for Foreign Affairs, Lord Halifax made no attempt to gloss over the facts, unpleasing as they may be, or to ignore the grave dangers for the future of civilization which they imply. The one fact by which above all he is appalled is that this "waste land" we live in, as the present state of European civilization has been called, has been brought about not by the mistakes, the pride, and the selfishness of an older generation, but by that of youth, deprived of the elements of true judgment, which has been the driving force behind the Nazi movement. But, if on one side force is an instrument of aggression, on the other, youth will fight to break down the barrier which must be broken down, if the youth of Europe is to avoid living always in this "waste land".

The antagonisms which have brought about the present conflict in Europe are by now familiar in terms to all; but as formulated by Lord Halifax before an audience composed largely of those whose task will be to ensure that right prevails, they are seen to penetrate to the very fundamentals of human associations. On one side is an all-embracing and overpowering system—a system based on the conception of the so-called economic man—and over against it the ideal which has made as its end the perfection of the individual "in the conviction that here, too, lay the secret of life for all society". It must be remembered that "the substance of any conventional code . . . must derive from the depreciation by society of the principles of its own survival" and, he went on to say, "If we are to recapture the secret of order for international society . . . we must as individuals strive to erect or maintain standards that will bring true freedom through the way of discipline". If any good thing can come out of so great an evil, it is that the outbreak of War has constrained the British peoples to reason with themselves upon the nature and aims of the societies in which they live. If there still be those in whose minds there lingers a doubt, they cannot fail now to see the issues clearly in the light of what Lord Halifax has said.

Universities in War-time

DR. RAYMOND PRIESTLEY, vice-chancellor of the University of Birmingham, devoted his address at the annual meeting of the Court of Governors of the University to a discussion of war conditions. He said that the university, until now, has fared very well. Numbers are almost up to normal and on the science and applied science side the great majority of students will remain until they have graduated. "Reservation is not intended to prevent, and will not prevent, university-trained youth from playing its part in the country's war effort. Their advent is merely deferred until they are fully prepared to pull their weight." In this way fully trained men will become available at the end of each academic year, and there will be a proportion able to play their part in the reconstruction that must follow the end of the War if European civilization is to make up leeway and resume its advance. Dr. Priestley went on to say that he believed it is not necessarily bad for young university men to pass through the Army, the Navy, or the Air Force on the way to their normal work in the world. He quoted his own experience of the War of 1914–18: "I came out of it a better man—more humane and better able to deal with situations and with men". When the War ends, the universities and university men will have a more important part to play even than in war-time, and it would be fatal if a false impression got abroad that university personnel claims to be set apart from the generality of citizens.

The recognition by the Government that the work of the universities of Great Britain is part of the national cause in the War has provoked criticism. Dr. Priestley believes this to be unfair. Indeed, he thinks that there can never have been an occasion when, in similar circumstances of national strain, a Government has been more far-sighted in this particular respect. In the War of 1914–18, education almost closed down. By the decision to refrain from enlisting the youth of the nation before the age of twenty, the Government has given technical and university education a chance to continue their task. For this purpose the universities require adequate finance. "They provide the technical experts on whom the servicing of the post-War world will depend. They provide the teachers who must tune to concert pitch the bodies and minds of succeeding generations. They ought to produce a large proportion of the enlightened leaders for the new era. Certainly if they do not, leadership, though it may be powerful, will not be enlightened." He also referred to the universities as "the chief repositories, exponents, and defenders of that freedom of thought that has been quenched in the totalitarian State".

Evacuation of Schoolchildren

THE Government Evacuation Scheme is reviewed in a Circular (No. 1965) to county councils and local authorities and an accompanying memorandum (Memo. Ev. 8. (London: H.M. Stationery Office. 4*d.* net)), which explain in detail the scheme recently announced by the President of the Board of Education. More than 400,000 evacuated schoolchildren remain in the reception areas, and the Government is of the opinion that dispersal of children from the evacuating areas is as desirable now as it was at the outbreak of the War. The first objective of policy is therefore to ensure that there is no further drift back of those children to the evacuation areas. To secure an equitable distribution of the burden of private billeting, householders in reception areas are to be invited to place their names on a roll, one of the primary objects of which will be to secure a list of persons willing to share with their neighbours in the care of children who have been billeted since the outbreak of war. Local authorities also have compulsory powers if the voluntary response is insufficient. At the same time, the billeting allowance has been increased to 10*s.* 6*d.* a week for all schoolchildren of fourteen years and over as from March 2.

The further plans to be made for evacuation are for schoolchildren only, and will only be operated if air raids develop on a scale involving serious and continuing perils to civilian population. Evacuation will remain on a voluntary basis, but parents registering their children will be asked to sign undertakings that they will send them with the school party if evacuation is ordered and that they intend to leave them in the reception area until the party returns. The areas to be evacuated will be the same as those evacuated in September 1939, but the decision to evacuate any area will be taken in the light of prevailing conditions. Not less than 36 hours notice will be given to any particular area, and specified parties will be taken as far as possible to specified destinations. Children found to be suffering from infection or disease or serious uncleanliness are not to be billeted on householders in that condition. While the fullest possible use is to be made of the camps provided by the Government, the contribution from this source is limited. To supplement this, each receiving authority is being asked to provide hostels available for about 5 per cent of the children to be received, utilizing for this purpose a certain number of empty houses.

Institute of Chemistry

IN submitting the annual report of the Council at the sixty-second annual general meeting of the Institute of Chemistry, Sir Robert Pickard, senior vice-president, who presided, owing to the death of the president, Mr. W. A. S. Calder, early in January, said that the Institute, as the professional organization of chemists, has assisted the Government in supplying its needs in technical personnel for industries essential in war-time. The roll of the Institute continues to increase and now numbers more than 7,550, more than five times as many members as were registered in 1914. Those who could remember the position forty years ago, and recall the difficulty at that time of making any headway in the profession of chemistry, have watched the astonishing increase in the number of chemists, their growing influence, the increasing applications of science and the steady absorption of chemical talent in industry and commerce, in Government and municipal service, and in the affairs of everyday life. The profession of chemistry now stands high in the public esteem as a very essential service.

The report of the honorary treasurer of the Institute shows that the Institute is financially in a sound condition. Referring to the burden of publication expenses, he expressed the hope that the fund which had been raised by the Chemical Council, from industry as well as from chemists themselves, will help to put the affairs of the publishing societies—the Chemical Society and the Society of Chemical Industry—on a sounder financial basis. The officers and council for the ensuing session were elected, the new president being Dr. J. J. Fox, Government Chemist.

Relics of Ancient Egyptian Royalty

THE black granite sarcophagus of Pharaoh Psusennes, discovered at San el Hagar, the ancient Tanis, by Prof. Montet of the University of Strasbourg (see NATURE, February 24, p. 300), was opened in the presence of King Farouk on February 28. Inside, it is reported (*The Times*, February 29), was a silver sarcophagus, about 7 ft. long, in the likeness of King Psusennes. On the head were the royal insignia, and in the hands, which were folded across the chest, were a sceptre and a flail. The state of preservation and the exquisite carving are said to combine in making this one of the most beautiful objects discovered in recent years. The silver sarcophagus was in two pieces. Inside it was another sarcophagus, of which the top was a silver-gilt body-covering and a gold mask, also a likeness of the king. On the chest are long inscriptions, apparently religious texts. The lower half of the coffin had been of some metal, which had completely disappeared owing to the damp that had seeped in between cracks. In consequence, the mummy also had disappeared, only a mass of mud being left, in which were a few bones.

On the removal of the sarcophagi, a mass of fine jewellery was found in the granite case. Twenty-one gold bracelets, ten from the right arm and eleven from the left arm of Psusennes, all bear inscriptions which trace the king's genealogical tree and give details which will be of importance for the history of a period obscure in its dynastic relationships. Inscriptions giving the names of the king's mother and uncles, pointing to a possible connexion with Thebes, have already been deciphered. Many gold necklaces, some adorned with rubies and scarabs, were found, as well as finger and toe cases of gold. Photographs of the site, sarcophagi, and some of the finds appeared in *The Times* of February 29.

University of Birmingham

AT the annual meeting of the Court of Governors, the Pro-Chancellor, Mr. E. P. Beale, welcomed, with relief, the announcement that the Treasury grant to the universities is not to be reduced. He also announced with gratification that contributions from the Birmingham City Council and the surrounding local authorities showed a substantial increase, due mainly to the grant of an additional £750 from the Warwickshire County Council. He regretted that it had been necessary, owing to lack of financial support, to close the Department of Industrial Hygiene and Medicine; he hoped the setback would be only temporary. He also referred to the endowment of a chair of theology by Dr. Edward Cadbury. The endowment fund (£32,000) is the largest individual benefaction received by the University in 1939.

The Nuffield Physics Laboratory is now occupied. The magnet of the large cyclotron has been erected free of charge by Messrs. Horsley Bridge and Thomas Piggott, Ltd., of Tipton, the steel for its construction having been supplied on most generous terms by Messrs. Colvilles, Ltd., of Glasgow. Prof. S. Zuckerman, who was appointed to the chair of anatomy to succeed Prof. R. D. Lockhart, is engaged on work of national importance and it has been agreed that, in consequence, he shall postpone taking up duty at Birmingham. Dr. C. F. V. Smout is continuing to act as temporary head of the department.

Higher Education in Palestine

THE Friends of the Hebrew University of Jerusalem have just published their annual report, 1938–39 (199 Piccadilly, London). This University is an important centre of culture in a distracted country and continues, we are glad to see, constructive effort, though faced with financial uncertainty. A new Medical Centre was opened last year, including a fine hospital with three hundred beds and first-rate equipment. For the present it will be mainly devoted to medical research and post-graduate courses. Progress has been made with agriculture and education, for which eight diplomas were awarded last year. The University is enterprising enough to broadcast popular talks on its work, and its friends are busy in Great Britain seeking to make up for losses due to the War. It is hoped that some special donations may help a large number of students who, coming from countries under German domination, can no longer receive the money on which they formerly relied. It is estimated that £6,000 will be needed for urgent cases.

The Hebrew Technical Institute, Haifa, has altogether more than seven hundred students and a staff augmented by some distinguished refugees. A Nautical School was started in 1938 and has its own training ship. The Daniel Sieff Research Institute has been experimenting, for the benefit of the orange industry, on peels and other waste products. Difficulties of transport will keep much of the present crop at home. Johnson used orange peel for indigestion, but it is scarcely likely to survive to-day as a remedy.

The Blind Spot

HELMHOLTZ, in his "Handbuch der physiologischen Optik" (1867), stated that the demonstration of the blind spot of the eye, the discovery of which was communicated by the Abbé Edme Mariotte to the Royal Academy of Sciences in France in the winter of 1667–68, was given before the King of England in 1668. Dr. J. Bröns, of Copenhagen, in a monograph on "The Blind Spot of Mariotte" (London: H. K. Lewis and Co., Ltd., 1939. 12*s.* net), proves that this statement is erroneous, and brings forward strong evidence of the manner in which it arose. In 1776, Georg Simon Klügel, professor of mathematics in the University of Helmstädt, published a translation of Joseph Priestley's "The History and present state of Discoveries relating to Vision, Light and Colours" (London, 1772). On p. 144 of the translation there is a footnote as follows: "(a) Smith's Opticks, Remarks, p. 6 (d. d. Ausg. S. 367). Oeuvres de Mariotte, p. 496. (Der Versuch ist 1668 vor dem Könige von England gemacht. Birch, T. 2, p. 281. Haller's Phys., T. 5, p. 470, K.)" The reference to Birch shows that the communication to the Royal Society was made by Oldenburg, and not by Mariotte, and there is good evidence that the king was not present at that, or indeed any other, meeting. The reference to Albrecht von Haller, also a footnote, is in his "Elementa physiolgiæ corporis humani" (Lausanne, 1763), also contained in his "Anfangsgründe der Physiologie", S, p. 470, Berlin-Leipzig, 1772. This reads as follows: "Factum ann. 1668 coram S. Reg. Maj. T. Birch, T.II, p. 281. Exstat oper. Mariot. p. 496, Ed. Holl.". Dr. Bröns thinks that Klügel expanded the footnote to "Factum anno 1668 coram *Sua* Regia Majestate", adding his translation "Der Versuch ist 1668 vor dem Könige von England gemacht", whereas it should read "Factum anno 1668 coram *Societate* Regiæ Majestatis"—"the experiment was shown before the Royal Society".

Progress at the British Museum

IT is strange to read in the recently published annual report of the British Museum of events like the special Thomas Cromwell exhibition and, in the Natural History Museum, the retirement of Dr. Tate Regan and succession of Dr. C. Foster-Cooper, which seem to be matters of ancient history, but perhaps that is inevitable when H.M. Stationery Office issues the Museum's Annual Report for 1938 at the end of 1939. The interest of the public in museums has been undoubtedly on the up-grade in recent years, and this is reflected in an increased attendance (7,720) at the Natural History Museum. It is more difficult to account for the serious fall of more than 80,000 in the number of visitors at the British Museum, where the total, still exceeding one million, was the lowest since 1926. Perhaps the decrease was a reflection of the international disturbances in the autumn of 1938, for the work involved in air raid precautions, in training the staff in anti-gas measures, and planning for the safety of the invaluable contents of these institutions obviously interfered with normal working in the departments. Yet in these museums good progress was made, both in the development of the exhibited collections and in the less spectacular research conducted in the laboratories. That this work should now have been brought almost to a stop is regrettable, if inevitable. The announcement recently made that certain galleries are to be reopened to the public, and that special exhibits of current interest are being arranged, will be widely welcomed.

Biology in Schools

THE latest report of the Joint Committee of the Four Secondary Associations shows useful and, indeed, necessary work for education in the way of criticism, protest and suggestion. Complacency about the success of evacuation is now being reduced. Authorities who commandeer schools for officials and leave school buildings in a defective state have much to answer for. Such unwise economy is strange, after reckless expenditure elsewhere. A subsidiary subject syllabus is printed which a sub-committee of biologists has suggested for a London Higher School Certificate, since separate syllabuses for botany and zoology are regarded as unsatisfactory. This scheme for biology includes six important subjects, from histology to heredity and ecology, though the last-named is reduced to the study of fauna and flora in a restricted area. A practical examination and a written paper, each for three hours, are proposed, but the former, if ill-done, will not mean failure in the subject as a whole. The wide ground is well covered but, as the average teaching time for the whole of the syllabus, including practical work, is three hours a week, is there not too much to get through ? Ambitious programmes tend to produce shallow knowledge which is soon lost.

Cave Man in Colorado

EXCAVATION of a cave near Durango, Colorado, it is anticipated, may afford evidence for an approximate early dating of basket-maker culture in the southwestern States. The investigation was carried out on behalf of the Carnegie Institution of Washington by Earl H. Morris. Evidence of occupation, according to a report circulated by Science Service of Washington, D.C., was found below three feet of accumulated debris. There were indications that the inhabitants had lived in one-room structures, with mud-coated floors and fire-pits, though how these constructions were built was not detected. Corn and pumpkins were grown, but the principal mode of subsistence apparently was by hunting.

The most significant find, however, consisted of charcoal, from which tree-ring sequences have been constructed each covering a period of at least one hundred years. These are not only independent of one another, but also of any known Indian tree-ring datings. As these last have now been carried back to about A.D. 150, unless, as Dr. A. V. Kidder has suggested, conditions in this area were entirely different from the normal for northern Colorado, this constitutes valid evidence for Basket-maker occupation of the cave at not less than approximately two thousand years ago.

A Preparation for the Control of Bleeding

A FAT-SOLUBLE vitamin, known as vitamin K, is indirectly concerned with blood coagulation, will reduce the clotting time of blood in cases of prothrombin deficiency, and will check certain forms of hæmorrhage, such as occur in obstructive jaundice and occasionally in new-born babies. Vitamin K is found naturally in alfalfa and hog's liver fat, it has been isolated and its chemical composition determined. Several related but simpler compounds are known possessing a physiological action similar to the natural vitamin K, and one of these—a methylnaphthaquinone—has been introduced for use in medicine by Glaxo Laboratories, Ltd., Greenford, Middlesex, under the name "Kapilon". Kapilon has been found to be a valuable agent for reducing bleeding in obstructive jaundice and in neo-natal hæmorrhage.

Institution of Electrical Engineers: Scholarships

THE following scholarships are open for award by the Institution of Electrical Engineers during 1940 : *Duddell Scholarship* (value £150 per annum, tenable for three years), open to British subjects less than nineteen years of age on July 1, for a whole-time day course in electrical engineering ; *Ferranti Scholarship* (value £250 per annum, tenable for two years), open to British subjects less than twenty-six years of age on July 1, who are students or graduates of the Institution, for whole-time research or post-graduate work of an electrical engineering nature ; *Swan Memorial Scholarship* (value £120, for one year), open to British subjects less than twenty-seven years of age on July 1, for whole-time research or post-graduate work of an electrical engineering nature ; *Silvanus Thompson Scholarship* (value £100 per annum and tuition fees, tenable for two years), for works' employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, for a whole-time day course in electrical engineering at an approved university or technical college ; *William Beedie Esson Scholarship* (value £120 per annum, tenable for two years, renewable in approved cases for a third year), for works' employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, for a whole-time day course in electrical engineering at an approved university or technical college. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Royal Society of Edinburgh: New Fellows

THE following have been elected fellows of the Royal Society of Edinburgh : Mr. E. B. Ball, president of the Institution of Mechanical Engineers ; Mr. J. Bowman, City water engineer, Edinburgh ; Mr. B. S. Bramwell, advocate, London ; Mr. J. Brough, lecturer in vertebrate zoology, University of Edinburgh ; Dr. A. F. Buchan, teacher of mathematics, James Gillespie's School, Edinburgh ; Mr. J. M. Caie, deputy secretary, Department of Agriculture for

Scotland; Mr. J. Cameron, formerly head of the Pharmaceutical Department, Peiping Union Medical College; Prof. J. W. Cook, Department of Chemistry, University of Glasgow; Dr. J. Coutts, lecturer in pharmaceutics and demonstrator in practical pharmacy, St. Bartholomew's Hospital Medical College, London; Mr. Satchidinanda Datta, veterinary research officer, Imperial Veterinary Research Institute, Calcutta; Dr. T. Elder Dickson, art master, George Watson's Ladies College, Edinburgh; Dr. A. T. J. Dollar, assistant in the Department of Geology, University of Glasgow; Dr. H. I. Drever, assistant in the Department of Geology, University of St. Andrews; Mr. W. McC. Harrowes, medical director, New Saughton Hall Private Mental Hospital, Polton, Midlothian; Mr. T. Hart, collector of the Trades House of Glasgow; Prof. C. F. W. Illingworth, Department of Surgery, University of Glasgow; Mr. J. G. Kyd, registrar-general for Scotland; Mr. P. R. Laird, secretary to Department of Agriculture for Scotland; Dr. Robert McAdam, lecturer in mining and surveying, Heriot-Watt College, Edinburgh; Dr. J. A. Macdonald, lecturer in botany, University of St. Andrews; Dr. A. E. W. McLachlan, clinical medical officer, Newcastle General Hospital, Newcastle-upon-Tyne; Dr. A. MacNiven, physician superintendent, Royal Mental Hospital, Glasgow; Prof. G. F. Marrian, Department of Chemistry in relation to Medicine, University of Edinburgh; Dr. E. R. A. Merewether, H.M. medical inspector of factories, Birmingham; Mr. R. M. Neill, senior lecturer in zoology, University of Aberdeen; Dr. H. B. Nisbet, lecturer in chemistry, Heriot-Watt College, Edinburgh; Mr. J. S. C. Reid, solicitor-general for Scotland; Mr. H. Riley, founder and headmaster of Strathallan School, Forgandenny, Perthshire; Mr. J. Thomson, distiller, London; Dr. H. M. Traquair, president of the Royal College of Surgeons of Edinburgh, lecturer on diseases of the eye, University of Edinburgh.

Announcements

THE council of the Royal Society of Edinburgh has awarded the Keith Prize for the period 1937–39 to Prof. F. A. E. Crew, for his papers and joint papers in the *Proceedings* of the Society within the period of the award, and in recognition of his valuable contributions to animal genetics; and the Neill Prize to Mr. James Wright, for his important paper on "The Scottish Carboniferous Crinoidea", published in the *Transactions* of the Society within the period of the award.

THE Senatus of the University of Edinburgh has awarded the Cameron Prize to Prof. E. C. Dodds, Courtauld professor of biochemistry in the University of London, for his work on synthetic œstrogens.

THE Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on April 2 and 16, at 3 p.m., by Prof. F. E. Weiss, on "Graft Hybrids and Chimaeras".

PROF. MAX BORN, Tait professor of natural philosophy in the University of Edinburgh, will give the distinguished visitor's address before the Royal College of Science Mathematical and Physical Society at the College on March 11 at 5.15. Prof. Born's address will be entitled "On Melting".

MR. T. T. PATERSON, curator of the University Museum of Archæology and Ethnology, Cambridge, will deliver the Swiney lectures on geology in the rooms of the Linnean Society on Fridays and Mondays, at 3 p.m., from March 29 until May 10 (April 19 excepted). The subject of the lectures, to which admission is free, will be "Geology and Early Man".

THE Committee on the Chemistry of Proteins of the Division of Chemistry and Chemical Technology of the National Research Council has been granted 3,600 dollars by Mr. Eli Lilly of Indianapolis, for the establishment of a National Research Council fellowship in protein chemistry. The fellowship has been awarded to Dr. I. Fankuchen, who will carry on X-ray research on proteins in the laboratory of Prof. B. E. Warren at the Massachusetts Institute of Technology.

THE twelfth International Congress of Psychology, which was planned to take place at Edinburgh in July 1940, has been postponed, though not abandoned. The invitation of the City and University of Edinburgh is not withdrawn, and the Local Organization Committee hopes that the Congress may still meet in Edinburgh when circumstances permit the continuation and completion of the preparations.

THE annual meeting of the Swiss Society of Internal Medicine will be held in Bern during May 18-19, when the following subjects will be discussed: the chemistry of vitamins and some enzymes, introduced by Prof. P. Karrer of Zurich; the hypovitaminoses in medical practice, introduced by Prof. Bickel of Geneva. Further information can be obtained from the president, Dr. Otto Roth, Kantonspital, Winterthur.

AN Argentine Society of Social Medicine has recently been founded at Buenos Aires.

A MONUMENT has been erected at Chateauroux, France, of Stanislas Limousine, the chemist, who invented wafers for unpleasant drugs and pipettes for counting drops, introduced coloured bottles for poisons, organized the first public laboratory, and first injected quinine hypodermically.

ACCORDING to an investigation carried out in Calcutta, more than 96 per cent of 887 maternal deaths were due to an avoidable factor. Puerperal sepsis accounted for 32 per cent, eclampsia for 18 per cent, hæmorrhage for 11 per cent, anæmia for 24 per cent, and septic abortion for 5 per cent. The chief cause of death from diseases associated with child-bearing was pulmonary tuberculosis, which accounted for 40 per cent.

LETTERS TO THE EDITORS

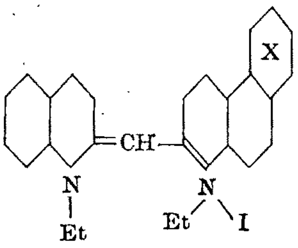
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

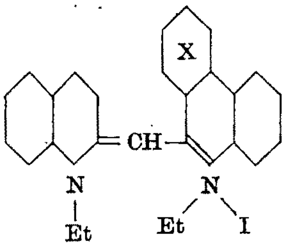
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 391. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Steric Influence in Optically Sensitizing Dyes

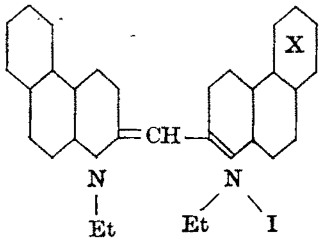
IN a paper by L. G. S. Brooker and C. H. Keyes[1], the preparation is described of certain isomeric cyanine dyes having the following formulæ :



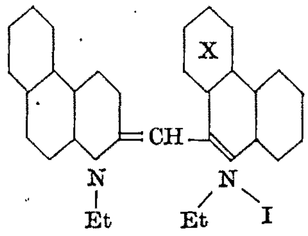
A



B



C



D

Brooker and Keyes noted that dyes *A* and *C* were strong sensitizers, while *B* and *D* did not sensitize. These substances were investigated later by J. A. Leermakers, B. H. Carroll and C. J. Staud[2], who confirmed the sensitizing results. But in addition they observed strong adsorption to gelatino-silver bromide grams of *all* the isomers, and "pronounced absorption maxima (by reflection)".

In recent work on these compounds we have observed, first, that the *rate* of adsorption to silver bromide from aqueous gelatin solution of dyes *B* and *D* is very much lower than for dyes *A* and *C*, although much the same adsorption densities (in molecules per unit area) were ultimately obtained. While this might account to some extent for lack of sensitizing (because of insufficient time of treatment), it does not appear an entirely sufficient explanation. A further complication was encountered in the form of a strong tendency of isomers *B* and *D* to bleach or fade, even in alcoholic solutions, probably by autoxidation.

On constructing the formulæ for these isomers, using correct bond angles and interatomic distances, it can be seen that complete coplanarity of the molecule is not possible in case *B* without bringing the 3,4-benzo-radicle within a distance of *ca.* 1·7 A. of the opposite quinoline group, and in case *D*, of the opposite β-naphtho-quinoline. This condition is not improved by 180° rotation of a nuclear group about a $=CH-CH<$ linkage to an alternate coplanar stereoisomer. The same condition obtains for 1,1′-diethyl-3′,4′-dibenzo-2,2′-carbocyanineiodide (having three methines between two phenanthridine nuclei), which was found also not to sensitize, but does not for 1,1′-diethyl-5,6,5′,6′-dibenzo-2,2′-carbocyanine iodide (having three methines between two β-naphtho-quinoline nuclei), which sensitizes strongly, and also not for 1,1′-diethyl-3,4,5′,6′-dibenzo-2,2′-carbocyanine iodide (having three methine groups between one β-naphtho-quinoline and one phenanthridine nucleus), and which definitely sensitizes.

On examining the absorption spectra (in alcoholic solution) of the non-coplanar isomers, it was observed that the half-width of the absorption band of maximum wave-length was much greater for the non-coplanar isomers than for their isomers, and the molecular extinction coefficients at $\lambda_{\max}$ were much less. There is also evidence that the yields are considerably lower than in synthesis of similar dyes which can readily assume a coplanar form of the fully extended (*trans-trans*) molecule.

It was suggested by Leermakers, Carroll and Staud[2] that "the phenyl group (*X*) in dyes *B* and *D* interferes with the proper exchange of energy between dye and silver halide, because of some steric effect in the molecule". The steric effect we believe to be the inhibition of coplanarity (cf. for analogous cases C. J. B. Clewes and K. Lonsdale[3], also J. M. Robertson[4]) of the dye molecule, and consequent interference with its resonance. In a fuller account the relation of coplanarity to adsorption (cf. Sheppard, Lambert and Walker)[5] will be discussed, as well as the temperature influence. The steric factor here indicated is of far-reaching importance in regard to the effects of substituents in the polymethine dyes.

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Feb. 2.

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[1] *J. Amer. Chem. Soc.*, **58**, 659 (1936).

[2] *J. Chem. Phys.*, **5**, 878 (1937).

[3] *Proc. Roy. Soc.*, A, **161**, 493 (1937).

[4] *J. Chem. Soc.*, 232 (February 1939).

[5] *J. Chem. Phys.*, **7**, 256 (1939).

Gattermann Synthesis of Aldehydes

The observation was made recently that hydrogen cyanide promotes the growth of certain fungi[1], which indicates the increased activity of the enzymes present in such circumstances. Earlier findings, on the other hand, had had some bearing on the mechanism of the mixed Cannizzaro reaction[2]. Investigations are now being carried out in this laboratory, in an attempt to contribute toward the elucidation of the mechanism of the Gattermann synthesis of aldehydes[3].

These experiments involve an adaptation of the original technique, using aluminium chloride, sodium cyanide (both chemically pure and "Aero Brand"), a solvent belonging to one of several series of hydrocarbons, and dry hydrogen chloride. They have already proved the practicability of this method[4]. The yields thus far obtained are evidenced by some data presented in the table below.

At the same time, the use of solvents belonging to homologous series has already outlined the basis of a rule relating the position of a given solvent in such a series to the yields obtained. The table, illustrating the results of an average series of trials, will serve to exemplify the latter point:

Formula of solvent	Name	C-atoms in side chain	Average yield %
PhH	Benzene	0	11
$PhCH_3$	Toluene	1	20
$PhCH_2CH_3$	Ethylbenzene	2	38
$PhCH(CH_3)_2$	Cumene	3	24
$PhCH(CH_3)(C_2H_5)$	sec.-Butylbenzene	4	3·5
$PhC(CH_3)_2(C_2H_5)$	tert.-Amylbenzene	5	7·5

Further investigations are in progress along several lines (including the influence of directive substituents), with a view toward clarifying some of the less evident features of the Gattermann synthesis.

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F. F. Nord.

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New York.

Dec. 26.

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[1] Dammann, E., Rotini, O. T., and Nord, F. F., *Biochem. Z.*, **297** 192 (1938). *Ergebn. Enzymforschg.*, **8**, 179 (1939).

[2] Nord, F. F., *Beiträge z. Physiol.*, 2, 301 (1924); *Chem. Rev.*, **3**, 65 (1926).

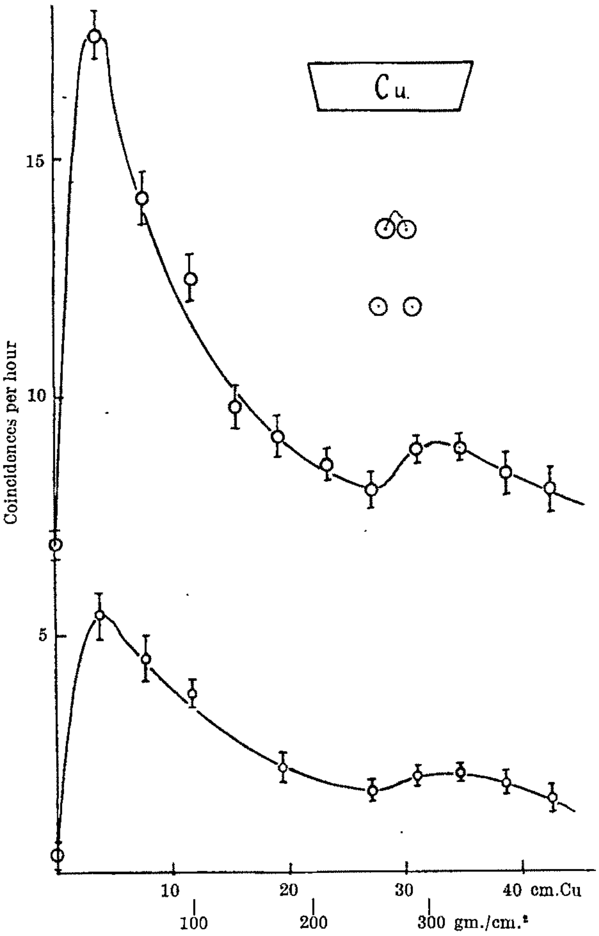
[3] Gattermann, L., *Ber. deut. chem. Ges.*, **31**, 1149 (1898).

[4] cf., however, Montgomery, E., and Adams, R.. *J. Amer. Chem. Soc.*, **46**, 1518 (1924).

The Second Maximum in the Rossi Transition Curve for Copper

K. Schmeiser and W. Bothe found a pronounced second maximum in the transition curve for cosmic ray secondaries from large thicknesses of lead. This maximum became the more pronounced the smaller the angle subtended by the counters at the absorber. W. Morgan and K. Nielson, on the other hand, found no indications of a second maximum for a counter arrangement similar to that employed by Schmeiser and Bothe, with the exception that the two upper counters were not joined together, while a rather similar curve to that of Schmeiser and Bothe was obtained when the upper counters were linked together. In this case the background rate was very much increased. This appears to show that the relatively high count under large thicknesses is connected with a high background rate.

In view of the fact that these two experiments are not in harmony, it was considered worth while to investigate the small-angle showers under large thicknesses of material, both when the upper counters are joined and when they count separately. The absorber used was copper, the angle subtended by the counter system at the absorber 6°. The curves obtained in the two cases are shown in the accompanying graph. When the upper counters were connected the background rate was certainly increased very much, but the characteristics of the curves remained essentially the same at large thicknesses. Both show a marked second maximum.



In the case where the upper counters work separately, and fourfold coincidences are counted, the number of counts without copper is very small, that is, the background rate is very small. Threefold coincidences, with the upper counters joined, show, on the other hand, a large background rate. The conclusion is that it is not the background rate which is responsible for the relatively high count at large thicknesses, but the secondaries from the material placed above the counters.

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Jan. 6.

Electronic Specific Heat of Graphite

In a previous communication[1] it was shown that the observed large diamagnetism of graphite along its hexagonal axis is that of its 'free' electrons, and is of the Landau type. At high temperatures it conforms to the Curie law $K = - n\mu^2/(3\ kT)$, and at low temperatures it tends to the temperature-independent value $K = -n\mu^2/(2\ kT_0)$, where n, the number of free electrons, is found to be just one per carbon atom, and T_0, the degeneracy temperature, is found to be about 520° K.; μ is the Bohr magneton.

These results fit well with the known electronic structure of graphite. From structural considerations we should expect one electron per carbon atom to be free, and its freedom of movement to be confined to the basal plane. This restriction of the freedom to the basal plane, besides directing the whole of the diamagnetism of these electrons along the normal to the plane, will also make the spacing of the energy levels of these electrons very narrow, and the degeneracy temperature very low, as required by observation.

This number of free electrons, namely, one per atom, together with the very low degeneracy temperature of the electron gas, should make the electronic specific heat of graphite at room temperature, and at low temperatures, much larger than that of most metals. Now the electronic contribution is most easily evaluated at very low temperatures, where the contribution from the lattice becomes relatively small. The available experimental data[2] for graphite extend down to about 29° K. only, and from these data the electronic part of the specific heat at low temperatures may be estimated roughly as 20×10^{-4} T. cal. deg.$^{-1}$ per gm. atom. This is more than ten times the electronic specific heat of copper or silver, and is of nearly the same magnitude as that of the transition metals, nickel, platinum and palladium.

It appears that even at 40° K. the electronic contribution to the specific heat of graphite greatly predominates over the contribution from the lattice.

K. S. Krishnan.

Indian Association for the
Cultivation of Science,
Calcutta. Feb. 9.

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[1] Nature, 145, 31 (1940); see also presidential address to the Physics Section, Ind. Sci. Congress, Madras Session, 1940.

[2] Nernst, W., *Ann. Phys.*, 36, 395 (1911); Magnus, A., *Ann. Phys.*, 303, 70 (1923).

Effect of Synthetic Vitamin B_6 on the Hæmopoietic System of Human Beings

Since vitamin B_6 (2-methyl, 3-hydroxy, 4,5-di-[hydroxymethyl] pyridine) is a constituent of liver and yeast, both of which relieve some of the symptoms of pellagra and pernicious anæmia in relapse, it was decided to give large amounts of this synthetic vitamin to pellagrins with macrocytic anæmia and to patients with classical pernicious anæmia. The observations of Fouts, Helmer, Lepkovsky and Jukes[1] show that dogs with a deficiency of vitamin B_6 in the diet develop a hypochromic anæmia which is not relieved by iron. These results have been confirmed and extended by McKibbon, Madden, Black and Elvehjem[2] in puppies. We have searched in vain to date for patients with hypochromic anæmia which did not respond to large amounts of iron. The vitamin B_6 used throughout this study was furnished by Merck and Company, Rahway, New Jersey.

The present report is concerned with the effect of the intravenous administration of from 50 to 100 milligrams of crystalline vitamin B_6 in sterile physiological solution of sodium chloride, each day for a period of ten days, to three pellagrins with macrocytic anæmia and to two patients with pernicious anæmia. Within forty-eight hours, the patients with pellagra and pernicious anæmia experienced considerable increase in sense of well-being and strength. On the fifth, sixth, seventh and eighth days of the study, in every instance, a slight but definite reticulocytosis appeared. The reticulocytes did not rise above five per cent, but the white cell count, which was extremely low in the two patients with pernicious anæmia, increased strikingly during the period of reticulocytosis. This increase was principally in the polymorphonuclear leucocyte series. One hundred milligrams of vitamin B_6, incubated with 100 c.c. of normal fasting human gastric juice, was given orally to one of the patients with pernicious anæmia after reticulocytes and white blood cells had reverted to the original low level, with a response identical to that observed following the administration of vitamin B_6, intravenously.

These findings suggest that vitamin B_6, when administered in large amounts, has a definite effect upon the hæmopoietic system of human beings who have macrocytic anæmia of pellagra or pernicious anæmia in relapse. This substance does not, however, in our opinion, act specifically either as the true anti-pernicious anæmia factor or as the extrinsic factor of Castle.

This study, an account of which was read before the Academy of Medicine of Cleveland, December 15, 1939, was aided by grants from the John and Mary R. Markle Foundation and Anheuser-Busch, Inc.

R. W. Vilter.
H. S. Schiro.
T. D. Spies.

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University of Cincinnati
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Cincinnati General Hospital.

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[1] Fouts, P. J., Helmer, O. M., Lepkovsky, S., and Jukes, T. H., "Production of Microcytic Hypochromic Anemia in Puppies on Synthetic Diet Deficient in Rat Antidermatitis Factor (Vitamin B_6)", *J. Nutrition*, 16, 197 (Aug. 10, 1938).

[2] McKibbon, J. M., Madden, R. J., Black, S., and Elvehjem, C. A., "The Importance of Vitamin B_6 and Factor W in the Nutrition of Dogs", *Amer. J. Physiol.*, 123, 102 (1939).

Effect of Stilbœstrol on the Ovaries of Hypophysectomized Rats

Various authors have reported that small doses of œstrogen injected in the intact adult rat cause an increase in ovarian weight, generally attributed to an increase in the secretion of luteinizing hormone from the pituitary[1].

Comparatively large œstrogen dosage causes a decrease in ovarian weight in the intact animals. The available evidence strongly suggests that this is due to a depression of hypophyseal activity[2]. So far as can be ascertained, however, little work has been done on the action of œstrogens on the ovaries of the immature hypophysectomized rat, though such a preparation should give valuable information about the direct action of œstrogens on the ovary. Accordingly, immature (40–50 gm.) female rats were hypophysectomized and a solid tablet of œstrogen was implanted subcutaneously two days after operation. The œstrogen used was the synthetic compound diethylstilbœstrol[3]. Two important effects were observed: first, that the œstrogen tablet prevented or greatly retarded the atrophy of the ovary that normally occurs after hypophysectomy, and secondly, that the response of the ovaries to the injection of pregnant mare serum was markedly increased with more pronounced luteinization of the membrana granulosa. Pregnant mare serum is mainly follicle-stimulating in action and has a much greater gonadotrophic action in intact immature rats than in hypophysectomized rats[4]. The tests on this substance were carried out as previously described[4], the animals being killed fifteen days after operation. The results are summarized in the accompanying table.

Condition of rat and treatment	Without œstrogen		With œstrogen	
	Mean wt. of ovaries (mgm.)	No. of rats	Mean wt. of ovaries (mgm.)	No. of rats
Normal	11·6 (10-13)	5		
Hypophysectomized 10–15 days post-operative	3·6 (2–7)	13	9·0 (6–15)	9
10 mgm. *PMS* 10	42 (27–59)	4	112 (79–168)	3
29 mgm. *PMS* 10	71 (57–95)	5	202 (106–250)	3
2·5 ml. *PMS* 11	35 (24–46)	5	81 (52–97)	3

PMS 10 is a concentrated extract of pregnant mare serum diluted with lactose, *PMS* 11 is a sample of pure serum diluted five times.

While it would be premature to speculate on the wider implications of these results, it is obvious that no action on the pituitary gland can be involved nor can the maintenance of corpora lutea play any part, since they are absent in the immature rat ovary. It is also clear that the role taken by the pituitary in the greater response of normal rats to gonadotrophic stimulation compared with the response in hypophysectomized rats will have to be reconsidered. It should be emphasized that the dose of stilbœstrol absorbed (as measured by weighing the tablets before implantation and at autopsy) was large, being 150–200 µgm. per day. This dose is much larger than any previously used in this connexion[5]. It is interesting to note that even these large doses did not produce any increase in the ovarian weight for normal animals of this size, so that œstrogen cannot be regarded as strictly gonadotrophic in the usual sense of the term.

Experiments are in progress to give more detailed information regarding the quantitative relations and histological changes of the œstrogen effect, and to test the reaction with other gonadotrophins.

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London, W.1.
Feb. 14.

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[1] See "Sex and Internal Secretions", ed. E. Allen, pp. 505, 987–992. (London: Baillière, Tindall and Cox, 1939.)

[2] See Deanesly, R., *J. Endocrinol.*, 1, 36 (1939).

[3] Dodds, E. C., Golberg, L., Lawson, W., and Robinson, R., NATURE, 141, 247 (1938).

[4] Noble, R. L., Rowlands, I. W., Warwick, M. H., and Williams, P. C., *J. Endocrinol.*, 1, 22 (1939).

[5] Fevold, H. L., Hisaw, F. L., and Greep, R. O., *Amer. J. Physiol.*, 114, 508 (1936).

Experiments in Non-Sensory Cognition

Two independent researches in this field have recently yielded mutually supporting results of considerable interest.

One of us (W. W. C.) used simple drawings as test material. In order to exclude processes of rational inference, and coincidental thinking, the subjects for these were selected by a random method immediately before each trial. Fifty such 'originals' were used, in five experiments of ten originals each. About 250 percipients took part, of whom none was ever in the same room as an original during a trial. In nearly all cases the original was put up in the experimenter's study and the percipients recorded their impressions, mainly by drawing, in their own homes. The whole of the material thus obtained (about 2,200 drawings) was marked against all fifty originals by a judge who had not been concerned in the experiment and did not know which original was which. Thus there was no possibility of the percipients inferring the probable nature of the original, or of their knowing it by sensory means, or of the judge's predilections biasing the outcome.

It was found (*a*) that percipients scored significantly more 'hits' (resemblances) on originals of experiments in which they were working, as compared with the originals of experiments in which they were not working, than would be expected on the null hypothesis that there is only a chance connexion between the originals used and the drawings produced ($P < 0{\cdot}0001$); and (*b*) that 'displacement' occurred to a significant extent; that is to say, 'hits' were not necessarily made on the same occasion as that on which the original concerned was displayed, but might be early or late, though most frequent on or near the occasion of display.

The other of us (S. G. S.) used specially randomized packs of cards, of which each bore one of five different symbols which percipients were required to name, under experimental conditions very carefully devised to exclude completely the 'leakage' of sensory clues to the percipient. A total of 128,350 guesses in 5,134 'runs' of 25 each was collected from 160 percipients. In 57,450 of these, the experimenter looked at the card while the percipient was guessing; in the remaining 70,900 cases he did not. The results at first sight were null, for in the first series the excess of successes over the expected number was only 51, which is less than the standard deviation, and in the second there was a deficiency of 160, which is only 1·50 times the standard deviation.

The discovery of a displacement effect, as recorded above, however, suggested a possible reason for the failure to score, namely, that percipients' guesses might refer to cards a few places before or after the one at which they were aimed. It was accordingly decided to examine the number of hits made on cards 1, 2, 3, etc., places before and after the guess.

As a start, two percipients, one of whom had done 2,000 guesses and the other 800, were scored in this way up to a displacement of eight positions in each direction. In the first case, the three central positions show an excess of 178 hits over expectation, equivalent to 5·82 times the standard deviation, giving $P < 10^{-8}$; in the other, the excess is 86·8, or 4·49 times the standard deviation, giving $P < 10^{-5}$. Either of these gives a highly significant result, even if taken as the best sample of the whole material.

Thus the results of the card-guessing experiments confirm the displacement effect discovered in the experiments with drawings; and these have led to a type of effect in the card-guessing being brought to light which might otherwise have escaped notice.

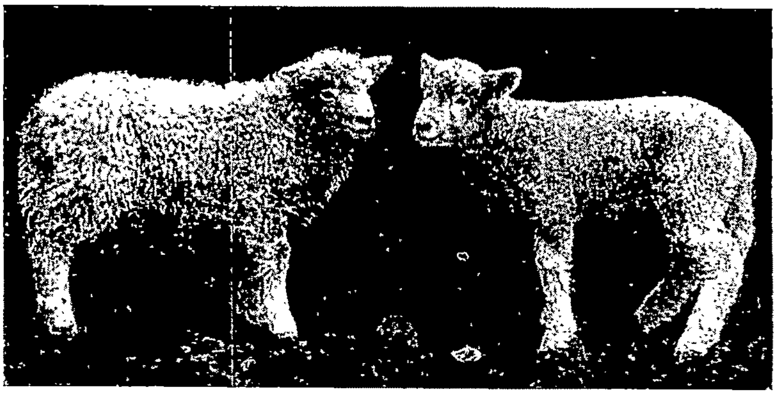
Full substantiatory details of both investigations will be published shortly.

W. Whately Carington.
Cambridge. S. G. Soal.
Feb. 4.

A Mendelian Situation in the Birthcoat of the New Zealand Romney Lamb

In our work on the inheritance of the abundance of halo-hairs in the birthcoat of the New Zealand Romney lamb, interest has become centred in a genetic situation which we find ourselves a little surprised to encounter in a character of a marketable product of livestock other than colour. While complexities are not lacking, it is plain that we are dealing with something more clear-cut than the usual multifactorial flock of factors defying genetic analysis.

Lambs with gross abundance of halo-hairs on the main area of the body, as well as on the extremities, are reported by breeders to make their appearance from time to time. It is safe to say, however, that they are not very common. These 'gross' lambs we call N-type, N being the initial letter of the name of the breeder, Mr. N. P. Nielsen of Tiakitahuna, who gave us our first ram of the type in question. In several N-type lambs born in various experimental matings, it is concluded from their ancestry and/or breeding performance, that the genetic basis is multifactorial, but in most N-type lambs born at the College the genetic basis is manifestly relatively simple. This is a summary of our findings from experiments in which well over a hundred N-type lambs have been produced.



Left: N-type; right: not-N-type. The latter had no halo hairs on the main area, but many not-N lambs have some halo-hairs there, even large numbers, but characteristically fewer than N-type. These lambs are twins. The father was N-type, the mother not-N, with no halo-hairs. The sire of the father was N-type, the dam of the father had no halo-hairs.

(1) Breeding results from two N-type rams, not related to one another, together with results from rather numerous N-type descendants of theirs, make it look as if this kind of coat were conditioned by a single dominant factor linked with the sex-influenced factor for horns, with crossing-over occurring about once in ten or twelve times.

(2) Some attention has been paid to horns by one of us (J. A. S.). It happens that horns have been rather plentiful in non-N experimental stock. On the average the horns are decidedly bigger in N-type than in non-N rams.

(3) Several pieces of evidence indicate that this N factor (or possibly N complex) sometimes comes to incomplete expression, so that the lambs fall a little short of the abundance of halo-hairs regarded as properly gross. It may suffice to mention the following two points:

(a) In back-crosses of horned N-type rams deemed double heterozygotes, most of the near-N male offspring have horns.

(b) Most of the ewes chosen for back-crosses had few or no halo-hairs on the back. The lambs could be separated almost sharply into two groups, those of the N-type and near-N-type and those with few or no halo-hairs on the back. There were very few with intermediate abundance of halo-hairs.

(4) In back-crosses of heterozygous N-type (so regarded from their parentage) to not-N, some ratios are almost exactly 1 : 1, but in the offspring of some tested rams there is a deficiency of N-type, that is, an excess of lambs definitely not-N. Whether this deficiency of N-type is significant, and how it is to be interpreted if it is real, are matters calling for further experiment.

(5) One N-type ram, with all his parents and grandparents not-N, was mated with not-N ewes with no, or few, halo-hairs on the back. He sired 3 N-type, 1 near-N, and 60 not-N. So far he has been mated with only four of his own daughters (all not-N), getting one of the N-type lambs and the near-N lamb just mentioned, and 2 not-N. One of the other N-type lambs was from a daughter of one of our original N-type rams.

(6) (a) A not-N ram sired by the original Nielsen ram was mated with not-N ewes sired by the same ram. He gave 10 lambs, all not-N.

(b) A not-N ram (without any halo-hairs on the back), the son of an N-type son of the original Nielsen ram, was mated with not-N ewes (with no or few halo-hairs on the back), daughters of the original ram or one or other of his N-type sons. The result was 2 typical N-type, 9 not-N with halo-hairs absent or of low abundance on the back.

We are able to suggest more than one somewhat elaborate explanation of our list of facts. Two linked complementary factors for N-type are favoured by one of us (P. R. McM.), while a dominigene is the pivot of another hypothesis. We are reminded of the recent work on another domestic animal by Kurzbauer and Marchlewski, who find that "two yellow dogs may produce black offspring and two black ones may produce yellow"[1].

F. W. Dry.
P. R. McMahon.
J. A. Sutherland.
Massey Agricultural College,
Palmerston North,
New Zealand.
Dec. 11.

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[1] *Animal Breeding Abstracts*, 7, 2 (1939).

Air Transport, Insects and Disease

I HAVE read with much interest Dr. A. D. Imms's review (in NATURE, January 13, p. 76) of Mr. Sarel Whitfield's paper entitled "Air Transport, Insects and Disease", and agree with both the author and the reviewer that the present position of this problem is still unsatisfactory.

In Dr. Imms's opinion, "no adequate and reliable control of insects in aircraft has been discovered", which is true of insects in general, but is scarcely so of the class of insects to which he especially refers, namely, the carriers of malaria and yellow-fever. The evidence brought forward in our paper[1], supported as it was by the opinion of reliable observers, shows that adequate control of mosquitoes in aircraft can be effected if the measures devised by us, and by Dr. Park Ross, are carried out.

The reason why these measures have not been generally adopted is, first, because the provisions of the International Sanitary Convention on Aerial Navigation place the responsibility for insect destruction on the ground sanitary authorities of the various countries through which the aircraft passes; and secondly, because these local Governments are averse to delegating their responsibility under the Convention to aircraft companies, with the result that a variety of different insecticides is still being used, and the manner of their application is equally varied.

Dr. Imms's criticism is valid when applied to some other arthropods, and we have had correspondence recently regarding the possible carriage in aircraft of the cotton boll worm and of the Japanese beetle. We realize that the procedure devised for mosquitoes would be entirely ineffectual when applied to such parasites, and eminent entomologists, both at home and abroad, have been asked to advise us regarding a substance lethal to these arthropods and yet of practical application in a passenger-carrying aeroplane.

Until such a preparation has been found, it is obviously impossible for aircraft companies to proceed in the matter. We consider that we have a method, adequate and trustworthy, against mosquitoes; but until the biochemical side of the problem has been extended, we cannot take measures to destroy the more resistant parasites which may carry veterinary or agricultural disease.

If Mr. Whitfield's valuable monograph, and Dr. Imms's review of it, serve to direct attention to the nature of the problem awaiting solution, they will have done a great service to aerial transport.

F. P. MACKIE.
(Chief Medical Officer.)
Imperial Airways Limited.

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[1] Mackie, F. P., and Crabtree, H. S., "Destruction of Mosquitoes in Aircraft", *Lancet*, 447 (August 20, 1938).

Points from Foregoing Letters

THE presence of steric inhibition of coplanarity in certain polymethine (cyanine) sensitizing dyes is discussed by S. E. Sheppard, R. H. Lambert and R. D. Walker. It is adduced as a cause of modified spectral absorption and inefficiency of optical sensitizing of silver halides.

A. G. Mistretta and F. F. Nord describe experiments and give indications of a rule with regard to the relation between solvent and yield in the Gattermann synthesis using sodium cyanide.

P. J. G. de Vos finds a second maximum in the curve for cosmic ray secondaries from copper similar to that observed by other workers using lead.

In view of the large number of 'free' electrons present in graphite, namely, one per carbon atom, and the very low degeneracy temperature of the electron gas, indicated by the magnetic data, it is pointed out by K. S. Krishnan that the electronic specific heat in graphite should be much larger than in most metals. The available experimental data support this conclusion.

It is known that both liver and yeast relieve some of the symptoms of pellagra and pernicious anæmia, and also that both contain vitamin B_6. R. W. Vilter, H. S. Schiro and T. D. Spies have administered heavy doses of this vitamin, intravenously and orally, to patients suffering from pellagra and pernicious anæmia, with beneficial results.

P. C. Williams states that the atrophy of the ovaries that follows hypophysectomy may be prevented, in the immature rat, by the implantation of a tablet of the synthetic œstrogen stilbœstrol two days after the operation. The ovaries thus maintained respond to the injection of pregnant mare serum, both quantitatively and qualitatively, much more like the ovaries of intact rats than like those of untreated hypophysectomized rats.

W. W. Carington and S. G. Soal, working with simple drawings and with special cards respectively, under the most rigorous possible conditions, find significant cognitive relationships between the test material and the guesses made. In the first case, percipients score more hits on the drawings used in the experiment in which they were concerned than on those of other experiments; in the second, two sample percipients have been found to score heavily above expectation on the three cards preceding, coinciding with and following the guess, taken as a group.

Certain lambs of the New Zealand Romney breed are born with great abundance of so-called halo hairs in the fleece. F. W. Dry, P. R. McMahon and J. A. Sutherland have examined this condition genetically. Mendelian inheritance of the character is indicated, but no agreement has been reached as to the factors and mechanism concerned.

The Chief Medical Officer of Imperial Airways, Ltd., writes to confirm a comment made by Dr. A. D. Imms that the present position with regard to air transport in its relation to the transmission of disease by insects is unsatisfactory. He states that satisfactory measures against mosquitoes have been devised, but are not generally adopted because the responsibility for taking action is in the hands of the ground sanitary authorities instead of the aircraft companies. Measures against insects other than the mosquito are being sought.

RESEARCH ITEMS

Mangarevan Archæology

IN the course of the expedition to the Mangarevan Islands of the Bernice P. Bishop Museum, Honolulu, under Dr. Peter H. Buck in 1934, an archæological survey of sites on Mangareva itself as well as of stone structures on neighbouring atolls was made by Kenneth P. Emory (*Bull.* 163, Bernice P. Bishop Mus. 1939). Owing to the use of the stone for building by missionaries all important structures in the Mangarevan group have now disappeared; but fortunately the stone structures left by the Mangarevan inhabitants of Temoe atoll, 25 miles to the south-east, are intact. Here the largest structure is a platform 21 feet wide and 58 ft. long. It has an unenclosed court on the inland side extending 30 feet from the face of the platform. Across the court face are two high steps. The largest structures in Temoe had burials in small vaults at the top. In two maraes, open vaults at ground level are larger and more carefully constructed than the vaults containing burials. These, it has been reported, were considered the dwelling-place of the god of the marae. The nearest parallels to the Mangarevan maraes are certain image *ahu* of Easter Island, in which the platform is stepped on the court side, and at the top of which burials were made. The Easter Islanders added images of stone along the back of the platform. Probably the features shared by the Mangarevan and Easter Island structures had a common origin, possibly original features of Marquesan culture with which both Mangareva and Easter Island exhibit affinities, but which evidently have been modified in the Marquesan, where sacred structures are not uniform, nor of the type of Mangarevan and Easter Island sanctuaries. However, like the Easter Islanders the Marquesans set up large images on their sacred structures; but the Mangarevans lacked both the timber and the tuff which would have permitted the making of such images.

Toxicity of Snake's Venom

IT is the general impression, and has been definitely stated by workers in America and Australia, that snakes in captivity from which venom is repeatedly extracted gradually yield smaller quantities. and that the venom decreases in potency. These statements are not confirmed by the observations of N. O'Connor Wolff and Thomas S. Githens made upon a group of twenty-one water moccasins (*Agkistrodon piscivorus*), used for venom extraction over a period of two years (*Copeia*, 234; 1939). The 'milking' took place at irregular intervals, the longest time between extractions being six months and the shortest three weeks. The venom having been collected was measured, centrifuged to remove epithelial scales, and then dried either by gentle heat or in a desiccator under vacuum. Toxicity was determined by intravenous injection into pigeons of a solution of the dried venom to determine the minimum lethal dose. A table is given recording complete data regarding the extractions over the two-year period. At the earliest extractions the average amount of venom per snake on the first three occasions was 0·500, 0·486 and 0·517 c.c., while on the last three extractions the averages were 0·550, 0·777, and 0·722 c.c. Similarly the first minimum lethal doses averaged 2,000, 1,300 and 1,577 per snake, while the last three averaged 2,520, 1,970 and 2,500. The table shows a considerable range of fluctuation throughout the period, but seems to establish the contention of its authors that neither quantity nor toxicity decreased owing to repeated extractions.

Marquesan Insects

THE Pacific Entomological Survey, dealing in the main with the fauna of the Marquesas Islands, is a project organized and directed by institutions in Hawaii. As the result of expeditions sent out under its auspices a large addition to knowledge of the insects, and related arthropods, of the area concerned has been made. Under the title of "Marquesan Insects—III" published in 1939 as *Bulletin* 142 of the Bernice P. Bishop Museum, Honolulu, the latest contribution on the work of the Survey has come to hand and it marks the end of the present programme. The longer articles in the *Bulletin* are concerned with Crustacea (Talitridæ), Spiders, Acarina and Chelonethida. Among the insects themselves, the article on Scolytidæ by C. F. C. Beeson is of interest since it records the first known bark beetles from the Marquesas; more than two hundred specimens, representative of five genera and twenty-one species, were dealt with. Two new genera of Hydrometridæ, or water-bugs, are described by H. B. Hungerford, and a new Blastophaga from the indigenous Ficus of the Marquesas is dealt with by G. Grandi. Other papers on the Insecta include contributions by H. H. Knight on new species of the hemipterous family Miridæ.

Experimental Taxonomy

J. W. GREGOR (*New Phyt.*, 38, 293–322; 1939) has continued his analysis of wild populations by examining the differentiation of North American and European plantains. He shows that *Plantago maritima*, *P. alpina*, *P. carinata*, *P. juncoides*, and *P. oliganthus* of North America, Greenland, and Europe form an inter-fertile group which is diploid, while Alpine tetraploids form another group. He points out that variations within one sub-region overlap with those of another, but that the means of measurable characters within a population may differ from the mean of another population. Thus bracts and sepals of North American plantains are broader in proportion to length than those of northern Europe. The mean values of the sub-regions regarding this index and that of the ratio scape length to spike length show a gradient from low values in western America, rising in eastern America, Iceland, Faroes, Britain to a maximum in Sweden, and falling again in southern Germany. Data regarding various other measurable characters show similar geographical gradients, but it is important to note that irregularities in small localities sometimes occur. The author points out that classification founded upon the complex of characters in an individual is not so useful in experimental taxonomy as that of the average of characters in a population. The data illustrate the fact that growth and physiological characters behave in a similar manner to qualitative or morphological characteristics.

Diamond Deposits of Tanganyika Territory

Although diamonds have been worked in Tanganyika for sixteen years, no comprehensive publication covering the geological and economic aspects of the industry has appeared until now. *Bulletin* 12 of the Geological Division, T.T., by G. J. Williams, comes at an opportune time, just as the original finds are reaching the end of their productivity, since it gives an account of most of the country in which kimberlite (the home of the diamond) is known to occur, and provides a useful guide to prospectors in other areas. The kimberlite occurrences are mainly in the central granite batholith of Tanganyika. The individual pipes tend to be localized at or near geological contacts (for example, against dolerite dykes or remnants of basement rocks) or fracture zones. There are, however, groups of pipes without visible connexion with pre-existing structures, owing—at least in part—to the existence of thick covers of superficial deposits. Here the search for such minerals as ilmenite, garnet and zircon in the subsoil is most likely to lead to the body of kimberlite from which they were derived. Areas likely to repay prospecting are suggested. From evidence in Tanganyika alone, the age of the kimberlite masses cannot be determined exactly. They are, however, pre-Pleistocene and post-early Jurassic; a time-range within which falls the late Cretaceous age established for the South African pipes. The *Bulletin* contains a map of the kimberlite province of Tanganyika and also a map showing the distribution of kimberlite pipes and fissures throughout Central and Southern Africa.

The Quetta Earthquake of 1935

This earthquake has been studied in some detail by K. R. Ramanathan and S. M. Mukherji of the Colaba Observatory, Bombay (*Rec. Geol. Surv. India*, 73, Pt. 4, 483–513; 1938). It will be recalled that damage was caused by this earthquake along a tract of land extending from Baleli just north of Quetta, through Dingar and Mastung to Mand-i-Haji, and including the Shirinab Valley to the west of the Mastung–Kalat Road. It is an area about 68 miles long and 16 miles wide. The surface crack extended from about 30·3° N., 66·9° E., to 29·1° N., 66·5° E., the centre of the region of maximum disturbance being 29·7° N., 66·7° E. The seismological data used for the present study were the seismograms from Bombay, Agra, Calcutta, Hyderabad and Kodaikanal in India, together with fifteen seismograms from foreign observatories. Miss Bellamy, of Oxford, supplied readings from 142 observatories. From these data the authors concluded that the best position for the epicentre was 29·6° N., 66·5° E., slightly to the southwest of the permanent maximum displacement but well within the region of maximum macroseismic effects. The origin time of the earthquake was May 30d. 21h. 32m. 58·5s. G.M.T. Among the prominent features of the seismograms were the gradual increase of amplitude interrupted by larger and larger impulses, and the large amplitudes of the long waves compared with those of the preliminary phases, suggesting block movement and a shallow depth of focus (less than 10 km.). This was also deduced on other grounds. The energy of the earthquake was estimated to have been about 10^{21} ergs. or 1/2,000 that of the Great Assam earthquake of 1897. A list of aftershocks recorded at Agra is given.

Viscosities near Absolute Zero

With financial aid from the Smithsonian Institution, Prof. W. H. Keesom and G. E. Macwood have determined the viscosities of liquid helium and hydrogen and of hydrogen vapour at temperatures near the absolute zero (*Leyden Comm.*, No. 254). Their method is that of the oscillating disk, which is 5 cm. in diameter and is suspended by a phosphor bronze wire of 0·05 mm. diameter and 25 cm. long in a cylindrical box of a little greater diameter, the top and bottom plates of which can be placed at various distances from the disk. The decay of the torsional oscillations of the disk were observed by the mirror, telescope and scale method. The apparatus was standardized by using in it helium gas of known viscosity. The viscosity of hydrogen is normal in both states. For the liquid it decreases from 210 micro-poise at 15° K. linearly to a little more than 150 at 18° K., then more slowly to 140 at 20° K. For the vapour it increases from a little less than 10 micro-poise at 14·5° K. to 13 at 21° K. linearly, and is independent of pressure. The viscosity of liquid helium is abnormal. It increases from 1·8 micro-poise at 1·3° K. at first slowly, then rapidly to 17·5 at 2·1° K., where there is some uncertainty. From this point it increases to 25 at 3° K. and to 29 micro-poise at 4° K.

Observations of the Zodiacal Light

Mohd. A. R. Khan, Begumpet, Deccan, has sent a description of his observations of the zodiacal light on December 17, 1939, at 5.30 a.m., Standard Indian Time. The phenomenon produced the impression of two cones, one within the other, the inner cone being the brighter of the two. The apex of the inner cone rested on γ Virginis, and ξ Virginis, β Libræ and μ Serpentis lay approximately on its northern boundary. On the southern boundary were 76 Virginis, 20 Libræ, and φ^1 and φ^2 Lupi. The apex of the outer cone appeared to extend to ρ Leonis, and 109 Virginis and π Hydræ were on its northern and southern boundaries, respectively. The light thus presented the appearance of a tall double cone, broad at the base near the horizon, and getting quickly narrower and narrower towards the apex. A similar configuration was observed on December 12 at 5 a.m.

Structures of Sulphuryl and Thiophosphoryl Fluorides

As the relations between bond length and bond character are not well understood for molecules containing semipolar double bonds, the investigation of SO_2F_2 and PSF_3 by the electron diffraction method (D. P. Stevenson and H. Russell, *J. Amer. Chem. Soc.*, 61, 3264; 1939) is of interest. The distances predicted by the standard covalent radii are P–F 1·74 A., P=S 1·95 A., whilst those found are 1·51 and 1·85, indicating resonance with a larger proportion of ionic structures than for the corresponding chlorine compound, and due to a considerable triple bond character made possible by the large electronegativity of fluorine and the small difference in electro-negativity between phosphorus and sulphur. The relatively small angle 99·5° F–P–F is not interpreted for lack of data. The S–F distance in SO_2F_2 is 1·56 A., which is less than the single bond distance calculated from the standard covalent radii, but the shortening is not so great as is found with the fluorine derivatives of phosphorus. Although there is much more shortening in the S–Hal bond in SO_2F_2 than in SO_2Cl_2, the S–O distance 1·43 A. in SO_2F_2 is the same as that in SO_2, SO_3 and SO_2Cl_2.

PREHISTORIC PEOPLES IN SOUTH AFRICA

DR. ROBERT BROOM'S recent discoveries in the Transvaal of important evidence bearing upon the origin and descent of man have tended to overshadow another field of anthropological investigation in South Africa which, though more localized in its application, ranks in African ethnology as scarcely of lesser significance for studies of the evolution and distribution of prehistoric racial types. The problem in question arises from the recognition by Dr. A. Galloway* in the skeletal material from the remarkable prehistoric sites of Mapungubwe and Bambadyanalo, recently excavated, of a new race, the Bush-Boskopoid, associated with and apparently responsible for the mining operations which figure conspicuously among the activities of the prehistoric inhabitants of Rhodesia. The physical characters of the race of miners, their relation to the Bantu-speaking peoples who later came to form the predominant population, and how far the Bush-Boskopoid of Mapungubwe constitutes the type, are discussed in a series of communications made recently to the Rhodesia Scientific Association (*Transactions*, 37; 1939).

In reference to certain human remains found in excavations at various times since 1934, which are recorded in detail by A. E. Phaup, the evidence of the prehistoric skeletal material as a whole from Rhodesia is summarized and discussed by Prof. M. R. Drennan.

By way of preface it is remarked that the remains, both male and female, appear to be those of indigenous natives living under tribal conditions, and using metals. They differ from the present Negroes of South, East and West Africa in that their skulls were longer and narrower than the average, their faces were more prognathous and their brains smaller. They were also shorter. They resemble the "Bush-Boskop" race of Mapungubwe and Bambadyanalo, and are similar to the more modern "Hottentot" type, seeming intermediate between Bush and Bantu, with some of the characteristics of both. They also show affinities to the Cro-magnon race of Europe. They buried their dead in caves and the ancient workings of prehistoric gold mines. The bodies were probably clothed or covered, and personal ornaments and small utensils were left on or near the body.

The remains were found in different conditions throughout Southern Rhodesia as follows:

Penhalonga. On the Umtali Mission Farm among a group of granite blocks and under the largest was a natural wedge-shaped cavity 50 ft. long and 20 ft. wide, which had been walled in. The floor was covered with bones and scattered groups of small beads of blue glass and ostrich-shell. Four skulls, three male and one female, were available for examination and were pronounced in a report by Dr. Drennan at the time to be "a good sample of some native group, . . . quite comparable to the existing groups of natives".

Makoni District. From a large limestone cave on Romsley extension farm came a human skull and tibia, animal bones, clay pots, grinding stones, a copper bangle and a spear-head. Dr. Drennan pronounced the skull to be female and "typically Bantu", closely resembling two Mashona skulls.

Carolina Claims, Mazoe. An almost complete female skeleton was collected by the late T. H. Wilson, of the Geological Survey, from the Carolina gold claims, about a mile south of Jumbo siding, in workings in a small hill of banded ironstone. The skeleton was found in reopening one of the old shafts. With it were eight rusty iron rings. Dr. Drennan's report states that the remains are those of a young female of native type aged about twenty years. The skull is comparable with that from Penhalonga, and "definitely negroid in every respect".

Eureka Mine, Sipolilo. Two fossilized fragments of a human femur were found in an ancient working of the gold mine. They show extreme degrees of platymeria and pilastering, features practically never occurring in this degree in Europeans, moderate in Bantu, but a marked feature of Bushman and Hottentot. A fragmentary skeleton of an infant found later, while indeterminate owing to age, is as regards the cranium typically 'negroid', while the mandible is definitely 'Bush-Boskop'.

Inyanga. Fragments of a skull from the Van Niekerk ruins, found lying under a large granite slab, apparently belong to a young female of about fifteen years of age. The measurements are very similar to those of the female from Penhalonga.

In his further review of the skeletal material from Southern Rhodesia as a whole supplementary to the report to which reference is made above, Dr. Drennan states that his interest in the ancient gold miners and other prehistoric inhabitants of Southern Rhodesia was first aroused by the skull from the Gwalo mine presented to the South African Museum by Sir Clarkson Tredgold in 1917. In this skull the features of Bushman, Hottentot and Bantu types are curiously and strikingly blended. Next came the skull from the Planet Mine, Bulawayo, which, while showing certain Bantu characters, is predominantly Bushman, and with reservation might be assigned to the Bush-Boskop group.

The material described by Mr. Phaup, though all legitimately prehistoric Rhodesian, falls into two groups—those with, and those without, a definite association with mining activities. In the mining group fall the Mazoe, the Eureka, and the Van Niekerk specimens; they all belong to the same physical type and are all women or children. The Makoni skull also belongs to the same physical group; but the group from Penhalonga seem to approximate more to the modern type.

While Dr. Drennan finds a considerable measure of agreement with Mapungubwe, there are also significant differences. The material from Mapungubwe and Bambadyanalo, to which Galloway applies the term Bush-Boskop, is not homogeneous, but includes three or four different elements. In the present series, however, there is no instance of the absolute long-headedness or big-brainedness of the Boskop race, so prevalent at Mapungubwe and Bambadyanalo, nor is their relative long-headedness to be accounted for as a mixture of Bushman and Boskop strains. For this we must look to a pre-negro strain. The pronounced prognathism of the present group emphasizes their negro character; but it is absent at Bambadyanalo.

It is thus impossible to reconcile the two findings at present; but it may turn out eventually that it is a difference between the exploiters of gold on one hand, who show a preponderance of Bush-Boskop character typical of the southern prehistoric peoples, and of the actual miners on the other hand, who show more negroid character inherited from northern pre-negro types such as Elmenteita man.

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* Galloway, A., "The Skeletal Remains from Mapungubwe in 'Mapungubwe: Ancient Bantu Civilization on the Limpopo' ". Edited by Leo Fouché. Cambridge, 1937.

Upper jaws of a Boskop type attracted the attention of Prof. Raymond Dart in 1938 to the Cornucopia site at Rusape, Umtali, on which Mr. Barnes Pope had been engaged in trenching with the view of discovering the nature of the material there, which had attracted the ancient industrialists responsible for the workings of which evidence had been discovered. The appearance of a Boskop type was unanticipated as all previous skeletons from ancient workings in Rhodesia had been described as Bantu (Keith, 1931) or Bush (Drennan, 1930).

Mr. Barnes Pope, excavating in depressed areas with a luxuriant growth of trees and herbage, which had been disturbed on a grand scale at some past period of time, revealed consistently four layers: (1) the vegetation layer, (2) the gravel or barren layer, (3) the fertile layer, (4) the bed-rock layer.

The bed-rock layer consisted of granite boulders and the disintegrated granite which forms the basis of the area in which the ancient miners worked. The material which attracted them was either the rich brownish-black iron oxide grains, to be used either as a cosmetic or as a source of metallic iron, or alternatively the tin, which though not now found in paying quantities, may originally have been rich. This layer varies from three to forty-five feet.

The fertile layer, from which all objects found underground have come, varies from three inches to several feet in thickness but usually is only twelve inches in height. Here are crude potsherds, skeletal remains, beads, slag, a button of melted tin, etc. Curious arrangements of objects have been discovered. Under a flat stone were thirteen stone phalli. Here there were no bones; but in another place a skull was found accompanied by fifteen phalli. A second skull was found at a depth of fifteen feet, but without accompanying objects.

It may be inferred that two forms of burial were practised: (*a*) simple and sometimes phalli accompanied burials at the mining face, probably burials of miners; and (*b*) cylindrical stone monument burials in the 'mine-filling', probably burials of important individuals.

The 'mine-filling' process can be separated into two distinct phases represented by the sterile layer, composed mainly of earth displaced by the miners, and the vegetational stratum-humus, twelve to eighteen inches in thickness, representing the flux of a considerable period of time—certainly several hundreds and it may be even thousands of years. At Zuurberg the humid period represented by the black soil over the former land surface is dated tentatively at 1800 B.C.

This date, which applies to the earliest levels in which occur 'Bushman' burials on the Zuurberg site, is correlated by Wells with the "classical rainfall maximum" of C. E. P. Brooks (1922), dated at a period extending from 1800 B.C. to A.D. 500. The assessment of rate of deposition in South Africa, however, is notoriously difficult and uncertain. The period under investigation was one of aridity and erosion, rather than of precipitation. The rate of deposition of earthy vegetable layers at the present day in South Africa has not been determined; but while it would be rash to jump to the conclusion that the 12–18 in. earthy vegetable layer is referable to the same period as the Zuurberg material, the tentative suggestion of "even thousands of years" may be no exaggeration.

At the same time, cultural evidence from certain sources which have been under review may point to the later limits, for which an approximate dating might be suggested. While weapons and implements of iron are very similar to those collected on ancient ruins of medieval date, or even to those of the modern iron-worker, certain assemblages of beads are comparable to those of the Great Zimbabwe acropolies, that is, of the ninth to tenth centuries of our era, though here again allowance must be made for survival in fashion.

Turning to the skeletal material found on the Cornucopia site, L. H. Wells, in describing the two skulls, stresses their great length and relative narrowness. Thus the more complete of the two measures 201 mm. at its maximum length, while the maximum breadth is only 130 mm., giving a cephalic index of 65·0. The corresponding figures for the second skull are estimated at: maximum length, 190 mm.; maximum parietal breadth, 127 mm.; cephalic index, 66·5 approximately. The cranial capacities, respectively, are 1,425–1,500 c.c. and 1,300–1,350 c.c. In both, the bones are thick and massive and slightly mineralized.

The feature, however, which is singled out as especially noteworthy is the remarkable size of the palate and the teeth. In the first skull, the longitudinal and transverse diameters fall just within the maximum recorded for the South African Negro while the height of the palatal vault above the grinding surfaces of the teeth is greater than in any Negro. Moreover, the form is different, the incisors forming an almost straight line between the canines. The palate is thus quadrilateral rather than horseshoe-shaped. Except that it is much higher in the vault, this palate agrees with the Boskop type.

Both skulls agree in presenting very few negro features, while of their non-negro features, the majority are proper to the Boskop type.

Yet although these skulls recall the Boskop type, they also diverge widely from it. The significance of these findings becomes apparent on reviewing the skulls previously found in similar circumstances. The number found in Rhodesia is small. Skulls examined by Shrubsall and Keith were classified as of negro type, but probably these conclusions call for revision in the light of further knowledge. Galloway has recognized both Bush and Boskop features from Penhalonga. The Cornucopia find has revealed the association with an ancient occupation site of skeletal remains which are predominantly of non-negro type. They represent a type which there is good reason to believe preceded the Bantu-speaking Negro. Such a strongly marked Boskopoid type is already well known in the southern portions of Africa. The same elongated and low-vaulted skull has been found among the Hottentots and, it has been shown, can arise from the mixture of large-headed Boskop and small-headed Bush types. The most remarkable development of the last few years in South African anthropology has been the demonstration by Galloway (1937) that "a homogeneous Boskop-Bush population physically akin to the post-Boskop inhabitants of the coastal caves" was associated with the Iron Age civilization of Mapungubwe. It is concluded that the Cornucopia people, if not identical with the Mapungubwe type, are very similar in most respects.

A SLIDING RATE ELECTRICAL METER

IN a paper published in the *Journal of the Institution of Electrical Engineers* of January, Dr. Unz of the Iraq Petroleum Co., Ltd., has suggested a new type of electrical meter, to replace the existing maximum-demand indicators. The object of the maximum-demand indicators is to enable the supply station to charge its consumers not only in accordance with the number of electric units consumed, but also in proportion with the demand on the station at the time during which they were consumed. In the early days of the use of this system, the meter bill consisted of two components, the first being at a constant rate for all demands not greater than a certain minimum rate, and the second component being charged at a higher rate when the demand exceeded this rate. The object was to influence consumers to be economical with their lighting when they were consuming at the higher rate. Economy at these times is most important to the supply company, which is otherwise forced to buy large quantities of expensive reserve plant, used only for a short time every day when the demand is excessive.

Improvements to the demand-charging system have been effected by means of peak-load meters, load-levelling relays and time-switches, as well as by various refinements of the tariffs, but these are of limited application. A meter is required which would automatically fix the price level of each consumed unit as a function of the power at which it is applied, and integrate such prices to a total amount. The consumer would know that the price of a unit consumed at half load would be much lower than that consumed at double full load. He could therefore endeavour to reduce his electricity bill by improving the load factor to the utmost, but need never be afraid of being penalized for exceeding his usual demands. The supply undertaking, on the other hand, would have the full benefit of a rational and simple charging system, without the necessity of providing duplicate measuring instruments and wiring.

An integrating watt-hour meter having a curve for the speed characteristic instead of a straight line would serve the purpose. The meter readings would then not be in kilowatt-hours but in what might be termed 'key-units'. These readings would be proportional to the amounts of money due, as in load-rate prepayment meters or in double-tariff meters with a single counter train.

The speeding-up effect described above can be obtained in a meter either by making the driving torque proportional to a power of the load higher than the first, or by reducing the retarding torque of the brake. Dr. Unz states that the latter method is constructionally easier, and in addition it has the advantage that the existing driving elements with all their compensating devices can be left untouched. The constructional details of the proposed braking element are shown, its equivalent electric circuit is considered, and its performance discussed. The reconstruction of the meter characteristic is outlined, and the errors and compensation methods briefly discussed.

The device offers new facilities in the application of demand charges. It works on the same principle as a standard watt-hour meter, and deviates from the latter only in regard to its speed 'characteristic'.

THE MUSICAL PITCH OF ORCHESTRAS

IN the English edition of the second quarterly bulletin of the "Centro Volpi di Elettrologia" published in Venice last year, there is an interesting article by G. B. Madella surveying investigations which have been recently made on the frequency of the reference note of an orchestra. The history of this problem was discussed in an article in NATURE of November 5, 1938 (p. 820), by Dr. G. W. C. Kaye, who also described the proceedings of the international congress which made recommendations in 1939 (see NATURE, May 27, 1939, p. 905).

Madella describes a series of measurements made during a period of a month in the Electro-acoustic Department of the Istituto Elettrotecnico Galileo Ferraris in Turin at the request of the Italian Committee on Acoustics. Some of the results obtained are given below. A standard frequency of 400 was obtained from that of the institution standard, which operates at 1,000. This gives an accuracy quite sufficient for the purpose. The two tensions thus obtained having the unknown frequency and the frequency of 400 are then applied to a copper oxide modulator. The frequency beat obtained in this way is applied to the plates of an oscillograph and then registered by means of a photographic recording machine. The accuracy obtainable varies according to the time-length of the note studied; as a rule, it is about a tenth of a cycle. Attempts to apply stroboscopic methods were unsuccessful as these methods tire the eye of the observer and are therefore not suitable for systematic measurements.

The tuning frequency, on the average, was found to be above 435; during the transmissions of operas and symphonic concerts, values of the order of 441 were observed.

During the transmission of piano performances or of performances comprising pianos and vocal or string instrument groups, lower frequencies were nearly always observed, often in the neighbourhood of 435, with differences of less than 0·5 cycle. At a violin and piano concert the frequency most often heard was 437·1, but at a symphonic concert the frequency most frequently noted was 442, the maximum being 444·8 and the minimum 439·7.

The results are partly explained by remembering that when a piano is accurately tuned, the tuning is maintained without variations of practical importance. Wind instruments, even if well tuned at the beginning, have a tendency after a time to increase the frequency of the emitted note because of the heating produced by the breath of the player. Finally, string instruments allow the player within certain limits to follow the tune of other instruments, and the same is the case with singers.

No evidence was found to confirm the generally stated order of variation in which the mean tuning frequency tends to increase during the execution of selections by an orchestra. The frequency of the pitch which is observed during the tuning of instruments before starting the performance tends to be maintained as a mean value during the whole performance. As few tests of this have been made, it would be advisable to make further investigations; if confirmed, it would be of importance in relation to the choice of the steps apt to modify the tuning frequency.

TEMPORARY PRESERVATION OF ANIMAL SPECIMENS

MR. J. R. NORMAN, of the British Museum (Natural History), has abstracted and translated the following from a letter he has recently received from Dr. Paul Chabanaud, of the Museum National d'Histoire Naturelle, Paris:

On learning the news of the sensational discovery of *Latimeria chalumnae*[1], there can be, I imagine, few naturalists who were not seriously perturbed by the thought that it was only by the merest chance that this extraordinary living fossil was not irretrievably lost. Indeed, our congratulations are due to all those who have succeeded in saving this priceless specimen, although we must deplore the fact that its final state of preservation is so far from satisfactory.

Even if fishermen do not often find a representative of the Mesozoic fauna in their nets, how very few of the interesting specimens captured by them daily throughout the world find their way to our museums or laboratories. Even in the case of the species well-known to science, the larger individuals are rarely, if ever, preserved, and our knowledge of the size attained by certain animals (for example, the halibut—*Hippoglossus hippoglossus* (L.); some of the Siluroids; and very many Elasmobranchs) rests largely upon hearsay, or upon the examination of fragments (for example, the 'saws' of *Pristis*).

Naturalists travelling abroad are compelled to forgo the collection of individuals exceeding a certain size (except in the form of skins), solely because their preservation by ordinary methods (alcohol or formalin) necessitates the use of containers so large that their transport is quite impracticable.

There is, however, an extremely simple and quite inexpensive method of preserving animals, both large and small, and in particular fishes: this is by the use of sodium chloride or sea salt. I speak with some knowledge on this subject, as I have used the method myself on many occasions.

All that is necessary is to place the animal in a basin or dish, or preferably on a board or something of a like nature, and to cover it with a heap of salt, being careful to introduce as much of the salt as possible into the mouth and gills, as well as into the abdominal cavity through an incision previously made in one side of the body. The effect of the salt, of course, is to absorb the fluids from the organism. After some hours, that is to say, on the next day at the latest, the specimen should be turned over, drained, and the diluted salt replaced by fresh.

If the animal is of small or moderate size no further treatment is usually required, but if of considerable volume it may be necessary to repeat the operation several times, care being taken to turn the body over each time. Naturally, the hygrometric state of the surrounding atmosphere will tend to accelerate or retard the process as the case may be.

The desiccation of the specimen must be made as complete as possible, since, of course, the sodium chloride does not fix the tissues, and its preserving powers depend entirely upon its strong hydrophilism, the organic tissues treated by the salt being dehydrated and at the same time rendered unsuitable for the proliferation of destructive organisms such as bacteria, moulds, etc.

Thus, it is absolutely indispensable, especially in warm and humid climates, to obtain this dehydration as rapidly as possible, the animal being, in fact, converted into a 'stock-fish', which can be readily packed in any sort of box or crate, with no other packing than the salt itself.

By using this method I have been able to obtain very large specimens of fishes (for example, *Psettodes belcheri* Bennett, a flatfish from the north-west coasts of Africa, and enormous heads of halibut from Newfoundland), which would have been extremely difficult, if not impossible, to procure otherwise.

When the specimen reaches the museum or laboratory it should be soaked in fresh water for just long enough for it to resume its natural form; after this, it can be finally immersed in alcohol or formalin. The complete elimination of the salt is quite unnecessary, since its presence does not harm the final preservation.

I have never experimented myself with a mixture of sodium chloride and sodium sulphate, although I understand that this has given excellent results.

Clearly, this method of salting does not represent the ideal treatment for histological examination, but I can assure you that, not only the external morphology, but even the macroscopic anatomy, is perfectly clear; external characters, bones, viscera, muscles and nerves can all be easily studied. Obviously, the same cannot be said with regard to the blood-vessels or the brain, since special treatment is usually required before undertaking research on these organs.

I do not pretend that the external shape of a salted fish will always compare favourably with that of one which has been placed while fresh in alcohol or formalin. The colours are altered; frequently the scales are displaced. Admittedly the salt is only a makeshift, but how very much better than putrefaction and complete ruin?

I have dealt only with fishes, but there is nothing to prevent the use of salt for the preservation of any kind of vertebrate, provided that such necessary precautions as cutting open the peritoneum and the stomach, etc., are taken.

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[1] NATURE, 143, 455 (1939).

SEVENTY YEARS AGO

Nature, vol. 1, March 10, 1870

Science Education in Germany

Prof. H. E. (afterwards Sir Henry) Roscoe, F.R.S., contributed a second article on this subject. The earlier article, dealing with the universities, appeared in Nature of December 9, 1869; the present article deals with the "Polytechnic Schools".

"The 'Polytechnicum' is an institution peculiar to Modern Germany. It has for its object the teaching of all branches of the sciences of experiment and observation, not only in their principles, but in their applications to the industrial arts; these applications not being merely treated as illustrations of science, but regarded as the main subjects for instruction, for the sake of the understanding of which systematic courses on theoretic science are given."

The article points out that the polytechnics are quite independent of the science departments of the universities, although both are State institutions and there are often working arrangements between them. The professors rank somewhat below those of the universities. Entrance is normally at seventeen years of age, that is, one year earlier than to the universities.

The continued separation of the universities from the polytechnics is harmful in that it encourages the tendency in the polytechnics "to neglect the *educational* aspects of science in considering its practical applications".

A Probable Cause of Malaria

J. Gagliardi, writing under this title, refers to the work of Count Castracane on diatoms, described before the Academy of the Lincei. In this work, according to Gagliardi, he discovered that "nothing is so fatal to the life of marine or even brackish water diatoms as a sprinkling of pure fresh water. . . . From this fact he comes to the very probable conclusion that the sudden dying away of myriads of diatoms, besides, perhaps, myriads of other living creatures, during the rainy season might be, if not the only, at least one of the most efficient causes of *malaria*".

Natural Science Schools at Rugby

An article appears, by the Rev. T. N. Hutchinson, on these new 'schools', which is accompanied by a plan and an engraving of a general view of the laboratory. The laboratory is 35 ft. × 22 ft., and intended to accommodate thirty boys. The benches are divided into compartments each of which includes a cupboard and two drawers, two shelves, two gas taps, sink and water supply. A room is provided for the lecturer, and the chemical lecture theatre seats fifty. The physics lecture theatre seats sixty.

M. Delauney is the new director of the Paris Observatory. [See also Nature, February 10, p. 235.]

Prof. Unger, of Vienna, a well-known botanist, whose death we reported last week, was, it is now stated, found murdered in his bed at Graz; and no trace of the murderer has as yet been discovered. A priest has taken this opportunity to assert from the pulpit at Cilly, Styria, that the body of the late philosopher had probably been destroyed by the devil himself, who had just claims upon his soul!

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

A Mistress of Method for the Manchester Training College of Domestic Economy—The Director of Education, Education Offices, Deansgate, Manchester 3 (March 15).

Lecturer in Metallurgy in the Technical College, Bradford—The Director of Education, Town Hall, Bradford (March 16).

Headmaster of the Skipton School of Art and the Skipton Technical Institute—The Secretary to the Managers, School of Science and Art, Skipton, Yorks (March 18).

Waterworks Engineer and Manager—The Town Clerk, Municipal Buildings, Poole (March 20).

Director of Education—The Director of Education, Education Department, Newarke Street, Leicester (March 27).

Director of the Geological Survey—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (April 12).

Assistants III for duty on Resident Technical Officer Staffs at Aircraft Construction Works—The Under-Secretary of State, Air Ministry (B.127), Department ZA, Harrogate, Yorks (quoting B.381).

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Development Commission. Twenty-ninth Report of the Development Commissioners, being for the Year ended the 31st March 1939. Pp. 133. (London: H.M. Stationery Office.) 2*s*. net. [212

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THE PLANNING OF RESEARCH

SOME time ago, Lord Chatfield gave a comprehensive account in the House of Lords, in reply to a question by Lord Strabolgi, of the organization of scientific knowledge and personnel in Great Britain in the prosecution of the country's war effort (NATURE, January 27, p. 134). Although speed of decision and action is vital in these days, it is perhaps as well that a fundamental question such as this should now be reviewed after an interval for reflection.

Broadly speaking, Lord Chatfield contended that the scientific talent of Great Britain is already mobilized to the best advantage. He pointed out that close contact exists between the civil directors of scientific research in the three Services, and urged that the professional ties of scientific workers who may be members of different departments would prevent departmentalism and facilitate the exchange of ideas. Lord Chatfield also laid special stress on the value of an annual review of the research work in progress in the research departments of the three Services. Similarly, pointing out that there is no central organization or clearing house for research between the three fighting Services, he considered that the existing organization is adequate to ensure that an invention gets into the hands of the appropriate expert as quickly as possible and that central organization might impose delay.

Satisfactory as this reply may be in many respects, it does not really deal with the fundamental problems which are agitating the minds of scientific workers at the present time, and indeed on some points of detail it is possible to regard Lord Chatfield as too optimistic. The demands of secrecy imposed by war-time are a serious if inevitable obstacle to the exchange of ideas, at least beyond a certain stage of development—possibly the most important of all from the point of view of practice. Moreover, there has already been a considerable curtailment of scientific meetings, which might well be rectified.

Lord Chatfield's reference to the annual review of Service research work and the dropping of long-range investigations which are not yielding immediate results, however advisable from a Service point of view particularly during war-time, touches on the first of the two major problems causing concern to scientific workers to-day. Already some science departments at the universities have adapted their research programmes in part to short-term problems which may soon be of urgent importance. In others, research has been interrupted or curtailed by transfer of staff or by requirements of the Services. In such circumstances, the problems of co-ordination between the various applied sciences and the integration of fundamental and applied research as a whole assume even greater importance. The progress of science and the needs of the present situation are daily widening the sphere of what must be regarded as practical research beyond the limits of present provisions.

Accordingly, it is being asked whether the existing structure and machinery of research are adequate to serve the needs of the country, whether in time of peace or in war. Secondly, the place and function of the universities, not merely in relation to the organization or prosecution of research, but also to the national life, are the subject of equally anxious discussion. The two questions are interlocked in numerous ways: the relation between the teaching functions and research activities of the universities; the endowment of long-range research; questions of professional training and training for leadership or citizenship, are all involved and in urgent need of attention.

To deal adequately with such major questions as these within the limits of a single article would be impossible, and for the moment our concern is chiefly with the adequacy of the present structure of research. This has been the subject of criticism in recent years, notably in the Memorandum on the Finance of Research prepared by the Parliamentary Science Committee, and by Prof. J. D. Bernal in "The Social Function of Science". More recently, it has been discussed by Dr. Bernard Lovell in "Science and Civilization" with the view of provoking further discussion.

A preliminary analysis of academic research was presented at the Dundee meeting of the British Association in September last, and this analysis has been included in a recent broadsheet, "The Role of Research", issued by P E P (Political and Economic Planning). Even this preliminary survey makes clear the extreme difficulty of estimating with any accuracy the man-power engaged in academic research. Research staff on a full-time basis is not readily distinguished from staff engaged in part in lecturing or demonstrating, and great difficulties are also encountered even in defining a university institution, especially in the spheres of technology and technical training.

An outstanding feature of this preliminary survey is its revelation of the insignificant provision made in universities in Great Britain for the study of descriptive and theoretical sociology. While the group of social studies as a whole is well represented, the bulk both of its staff and students is found in departments of history, economics or law; contemporary social relations are scarcely studied from any point of view wider than that of economics. An excess in the proportion of advanced students over the percentage figure for the staff is most marked in departments of chemistry, but also appears in education, history and economics. The serious strain imposed on the teaching staffs by this disproportion cannot be without effect on their research time.

This preliminary survey thus supports the numerous pleas which have been voiced for some re-orientation of research effort between the physical sciences and the social and biological sciences. The unbalanced distribution of research resources even in war-time is likely to be fraught with serious consequences, to some of which attention has been directed from the economic side. The difficulties encountered in evacuation schemes have already indicated the need for more objective social research, and the success of rationing and other measures imposed by the national emergency may increasingly depend on accurate scientific knowledge of social needs and problems.

On this ground alone, therefore, inquiry into the present structure of research appears to be justified. It is not disputed, as Lord Chatfield urged, and as Sir Robert Robertson observed when the B.A. report was presented at Dundee, that effective machinery of co-operation exists in the Advisory Council for Scientific and Industrial Research, the Agricultural Research Council and the Medical Research Council. The improvement in this respect in the last twenty years is entirely satisfactory. What is unsatisfactory, however, is the inadequacy of the resources available for such bodies, and their limitation to advisory functions as distinct from the initiation of policy. Dr. Lovell contrasts, for example, the £195,000 received by the Medical Research Council for research with the £3,000,000 spent every year on advertising patent medicines and the annual turnover of £20,000,000 from their sale.

A second unsatisfactory feature of the situation is the absence of a co-ordinating authority able or competent to divert available expenditure or resources from one major field to another as the need is demonstrated. Despite the established value of long-range research in providing the basis of technical advance, such fundamental research remains in the most precarious position of all. Its efficiency depends on continuity, and yet it is probably more liable to abrupt termination or interruption than any other type. The importance of provision for continuity, which is the only satisfactory guarantee that half-completed work may not be utterly wasted, can scarcely be overstressed. Something much more effective than the existing methods of co-operation is essential to initiate the rationalization necessary to bring the whole cycle of research into a comprehensive and ordered scheme.

Failure to realize the basic interdependence of research—that research, whether prosecuted in the universities, in industry or in Government departments, is not distinct but a part of the same mechanism—not only threatens to handicap the solution of problems of reconstruction in time of peace, but is also a real danger to the efficiency of our war-effort. Already it is clear that many of our difficulties in dealing with the problems of adjustment from a peace-time to a war-time economy are due to our past neglect of research in the social and biological sciences. Many aspects of administration and government, the directive part of man and most aspects of human values are largely untouched by scientific investigation.

It is this position which makes Lord Chatfield's account of consultation and contact between the different Service departments less reassuring than it might otherwise be. Even if there were a co-ordinating authority competent to sort out long-range investigations, discontinued as a result of the annual review of the Service departments, and ensure their continuity where desirable, we could not regard the position as satisfactory while there appears to be no means for initiating those researches on the social side, which may well have a decisive influence on national morale. It has to be remembered in this connexion that there is already a marked tendency in industry, for example, to ignore the lessons of the War of 1914–18 and the experience of the Industrial Health Research Board, as was pointed out at a recent symposium of the Industrial Section of the British Psychological Society (see NATURE, February 3, 1940, p. 174).

In comparison with the position during the War of 1914–18, the organization of research, of course, represents an immense advance. The Advisory Council of the Department of Scientific and Industrial Research is very clearly alive to the danger of interrupting research, and has already deprecated any hasty reduction of work by the research associations without careful consideration of its ultimate effect on the welfare of the industries they serve. While wise adjustment of research programmes may enable the various associations to anticipate and deal with problems requiring immediate solution, the Advisory Council is anxious that fundamental investigations should be continued so far as possible. The Government, moreover, is to continue its pre-War rate of grants.

Satisfactory as this position may be, the crux of the situation is in the universities, where by far the greater proportion of fundamental research is prosecuted. Apart from the ill-defined relation between teaching and research, there is considerable waste of time on routine constructional work owing to the absence of technical assistants and mechanics. This waste has not been recognized by the authorities, and in war-time the demands of munition work and other forms of national service are likely to accentuate the evil by increasing the already acute shortage of qualified assistants.

The fundamental problem of university research is, however, that of widening the front of scientific advance, and while preserving the independence of the research worker and avoiding any regimentation, of securing that the resources available are adequately distributed over the whole field of science, and particularly those branches of knowledge where fundamental advance is most urgently demanded to meet the needs of the nation. Some strategy of scientific advance is imperative if resources are to be maintained unimpaired under peace-time conditions; if they are attenuated in war, it may make all the difference between victory and defeat.

The first steps to some such co-ordinated strategy must come from within the ranks of scientific men themselves. It is a matter which concerns all classes of scientific workers, however effectively some of the stronger groups, such as the chemists, might contribute through their professional organizations to the removal of particular handicaps on efficiency. Through the Royal Society or the new Division for the Social and International Relations of Science of the British Association, something of a plan of advance should be elaborated, taking account of existing gaps in the front of science, the border-line territories which are apt to be neglected and the manifold needs of a society at war and of the reconstruction to follow. Only with such a broad plan as basis will it be possible to compute the effort required, and the extent to which existing resources must be supplemented or diverted.

Given such a plan, some type of executive authority and scientific General Staff will be required to carry it out. The nucleus should not be hard to find in the Advisory Council on Scientific Research and Technical Development and existing organizations. Here, however, as on the economic front, the primary need is for vision and drive. It is only when scientific workers themselves realize the immense possibilities in their hands that we can hope for the elaboration and execution of that plan. From them must come the pressure on their individual societies and associations for the formulation of a common policy, and the resolute attack on all forms of inefficiency and waste in scientific research, and on obstacles to its development. On them individually, too, must rest a large share of the responsibility for making both the Government and the public realize the value of the contribution which science could make and the means by which that effort should be organized and directed.

PRINCIPLES IN PHYSICAL SCIENCE AND FREE WILL

The Philosophy of Physical Science
(Tarner Lectures, 1938.) By Sir Arthur Eddington. Pp. ix + 230. (Cambridge: At the University Press, 1939.) 8*s*. 6*d*. net.

THE following process is recurrent in physical science. A certain amount of special knowledge, empirically accumulated and assorted, is tentatively cast into a comprehensive theoretical aspect. The theory, after having been gradually corrected by further experiments and after having created several new appropriate definitions, tends to acquire an unforeseen general validity. But, strangely enough, at the same time, when it has become an inalienable requisite for the orientation of all future experimental and theoretical research, the knowledge which its propositions are supposed to convey turns out to be more and more tautological.

Withdrawn from the action of forces, a body moves uniformly in a straight line; with a force acting on the body, there is a rate of increase of speed, proportional to the force. These laws were originally abstracted from empirical findings. Subsequent generalization turned them into the tautological assertion that a body moves uniformly in a straight line unless it does not, in which latter case the force is to be judged by the body's acceleration. An appropriate definition points out the relevant notion by giving it a name of its own (force). What is left of the law is the important hint: In mechanical problems, pray, pay primary attention to the *second* derivatives—it is *they* which matter.

The example is old-fashioned and would need re-modelling to-day, but it is simple and sufficiently illustrative. The three laws of thermodynamics (principle of energy, principle of entropy, Nernst's theorem) have acquired almost a similar standing. Though they are not tautological, it would seem a rather hypocritical broadmindedness to maintain that they are empirical regularities only and could be contradicted by experiment at any time. I should not venture to oppose a view which in these and similar cases (for example, that of the special theory of relativity) went so far to the other extreme as to hold that the content of the theory had been switched over—intentionally or inadvertently—from empirical regularities to essential ingredients of our method of attack on problems of physical science, and had thereby been both deprived of the benefit and withdrawn from the danger of being checked by experiment.

The book under review goes further than that. It is said that recent advance in physical science has made us aware of the epistemological method, which consists in "examining the sensory and intellectual equipment used in observation" (p.18), and allows us to reach at least some of the fundamental laws of physics with "a security which is denied to those that can only be reached empirically" (p. 19). After the "replacement of physical hypotheses by epistemological principles" (p. 45), those laws turn out to be "compulsory and universal" (p. 45). This is "the equipment to put theoretical physics on a surer footing than it formerly aspired to" (p. 21).

Both views—that which I said I would not venture to oppose and Eddington's—claim the subjective character of certain fundamental laws. The peculiar brand of Eddington's subjectivism is best revealed by his incidental criticism of H. Poincaré's famous statement concerning geometry (p. 72). According to Poincaré, we can never decide by experiment which geometry is the right one, because any one will do, provided that the laws of physics to go with it are appropriately chosen. But they are functions of the geometry. We naturally, yet arbitrarily, decide for that geometry which gives our description of physical Nature the simplest form. It is thus not the "true" one, but the *comfortable* one, says Poincaré. If Eddington pointed out that, according to present knowledge, spherical geometry (with slight deviations for the local gravitational fields) was the only one not to entail an intolerable amount of inconvenience, I should agree. But, drawing on a quotation from "Science et Hypothèse" which, I confess, is a little daring and slightly over-stated, he declares that experiment, theory and epistemological research have definitely set an end to the happy-go-lucky times when we could allow a pure mathematician his extravagant dream of liberty to choose which geometry he liked.

I am probably not the only one who has always looked upon Poincaré's thesis as one of the most important revelations—and a genuinely relativistic one, at that. I consider it to be irrefutable and claim the same liberty of choice with respect to all those fundamental laws of physics (or constituents or features thereof) to which a purely subjective standing is duly attributed at any stage of the development of science. But the ease and simplicity of our description of Nature (or, if that is preferred, of our comprehensive report on our physical knowledge) is a function of our choice, showing usually a tremendous, almost selective, maximum for a particular choice. This is what determines the latter. As for the rest of the laws, I am not keen on calling them objective and anchoring them in an "objectively existing Universe" (which Eddington rejects). The *external world*, which he willingly grants (p. 209, p. 216), suffices for that purpose.

Another question of primary importance has received much attention, ever since the indeterminist view of quantum mechanics made its appearance in physics. Does the gap left in the predictability of events leave room for conscious volition to have its share in determining them? I cannot help being bewildered by the author's comments on this question. In the first place, he finds the limits of uncertainty left by Heisenberg's principle somewhat narrow for volition to get its proper share. He therefore pulls them down, claiming a *correlated behaviour* of the particles in, at least, some parts of brain-matter (p. 183). But Heisenberg's principle is supposed to be of epistemological origin (p. 99, p. 183) and therefore (p. 181) to hold also for brain-matter! Secondly, any kind of correlated behaviour or "demonic influence", whether outside the Heisenberg limits or within them, is bound to violate the second law of thermodynamics. If that is the meaning (and I am afraid it is), then the soothing statement (p. 181) about the "obedience of brain matter to the fundamental laws of physics which, being of epistemological origin, are compulsory for all matter", is grievously impoverished by the absence of a comma before "which". This is not the place to dwell upon my personal view, in which the alleged antithesis between rigid causality and free will is an illusion and the attempts to bridge it go so far astray as an attempt to explain the behaviour of an atom by its hunger or joy. But quite apart from this, say, prejudice of mine, I have always failed to appreciate the satisfaction felt about the gap which quantum mechanics is supposed to have opened for the purpose. The suggestion might be worth considering, if it succeeded without any exceptional law altogether. But there is actually no gap for volition to creep in, unless we are prepared, in certain exceptional areas, to sacrifice the Second Law. I do not consider that to be better or worse than it would have been thirty years ago, to abolish determinism in those areas.

There is still one question which I cannot repress: What is the source of the knowledge (p. 218) that "matter is normally unassociated with consciousness"? That a being organized much the same way as myself has likewise consciousness is a natural inference. But can it be inverted? Is not a certain likeness in organization the necessary condition for becoming aware of the fact? How should a galaxy, if it were associated with consciousness, and a human being communicate? The idea is that of G. Th. Fechner.

By not repressing my criticism of an author whom I deeply admire, I hope that I have, at least, conveyed to the reader how fascinating and stirring this book is from the first to the last page. There are many chapters upon which I could not comment at all—perhaps the most interesting ones. No man of science should miss reading the book. But with a work of Eddington's these are truisms. I propose to take a phrase on p. 113 as a motto for the whole—in spite of the author, who would certainly disagree. It reads: "I have been acting as an advocate for an extreme view, presuming that your natural prejudices are all the other way."

E. Schrödinger.

TALKS ABOUT GARDENING

Science Lends a Hand in the Garden

By Sir Frederick Keeble. Pp. xi+307. (London: Putnam and Co., Ltd., 1939.) 10*s*. 6*d*. net.

The leading articles in the weekly publication, the *Gardeners' Chronicle*, are frequently concerned with the application of recent scientific investigations to garden practice. A considerable number of these articles written by Sir Frederick Keeble are now brought together, carefully arranged and published in book form. The author states in the preface: "This book contains what are really talks about gardening——" "They don't set out to teach, but only to let gardeners know what people are gradually learning about plants and the soil they live in." The author certainly succeeds "In writing these things in the simplest possible way".

It is not feasible to direct attention to all the topics discussed; mention of but few must here suffice. The earlier chapters concern soil factors, fertilizers, and the humus content of soil and composts; a chapter is devoted to fruit, in which rootstocks, ripening and storage are discussed. Various environmental factors influencing the growth of garden plants are considered, and several pages are devoted to newly reported diseases and remedial measures; the production of new varieties by plant-breeding forms the subject matter of another chapter.

Many worthy garden plants are mentioned and there are hints on their cultivation and methods of pruning, together with brief descriptions of the peculiarities of some of these plants. The author has briefly drawn upon his wide experience in recommending some of the best shrubs.

The text reads easily; the charming literary style of Sir Frederick may gently persuade or beguile the reader to attempt more than "A chapter at a time" as is modestly suggested in the preface. When bringing to the reader's notice the results of recent research the author facilitates reference to the original work but does not quote fully 'chapter and verse'. There is an adequate index, but the book is without illustrations. A number of good photographs will always attract the keen amateur and general reader.

This book forms a general introduction to, and a brief review of, the progress made in applied botany (other than systematic studies), and is suitable for the general reader. It should interest botanists generally as it indicates many attractive problems yet to be solved. Few gardeners will fail to grasp the hand that science lends, and many amateurs will be grateful for the introduction so effected.

THE FUNCTION OF THE ADRENAL CORTEX

Die Funktion der Nebennierenrinde
Von Prof. F. Verzár. Pp. 266 + 4 plates. (Basel: Benno Schwabe und Co., 1939.) 25 Schw. francs.

VERZÁR, from whose laboratory have come many contributions to the knowledge of the function of the adrenal cortex, has published an extremely interesting monograph on this subject. A bibliography of more than 1,500 references is included, about 1,100 of which are from the last ten, and about 550 from the last three years. This illustrates the rapid progress recently made in the knowledge of this organ of which, as Verzár states, until a few years ago little was known except the fact that it is indispensable to life. Verzár gives a vivid impression of the rapidity of this progress when he describes, in the chapter on the chemistry of the cortical hormone, how the important contributions from three laboratories, from that of Kendall in Rochester, of Reichstein in Zurich and of Winterstein in New York, followed one another sometimes at less than monthly intervals.

In the early chapters the different methods are reviewed for removing the adrenals and for assaying the cortical hormone, and the history of its chemistry and identification is told. The last third of the book is concerned mainly with the conditions of hypertrophy and atrophy of the cortex, with its relation to other endocrine organs and with clinical observations. The material is well reviewed, and new suggestions are put forward. Some of the disturbances in the carbohydrate, fat, and ketone metabolism which develop after removal of the pituitary body can be restored to a great extent by cortin and may be regarded as signs of insufficiency of the adrenal cortex, which becomes atrophic after the operation. A detailed account is given of the morphological, chemical and experimental basis for the theory of production of sex hormones from the adrenal cortex under normal and abnormal conditions.

The main interest, however, centres around those chapters (vi to xv and xxii) dealing with cortical insufficiency and the functions of the cortical hormone. According to Verzár, it acts on the cell metabolism, enabling the processes of phosphorylation to take place in the cells. Lack of the hormone leads to impairment of phosphorylation in the organism, and the symptomatology of cortical insufficiency may be regarded mainly as the direct or indirect outcome of this disturbance. The starting point for this conception was a comparison of cortical insufficiency with iodo-acetic acid poisoning in which phosphorylation is impaired. Verzár was struck by the similarity existing between the two conditions, and the comparison has been the guide in the development of his theory.

The most conspicuous sign of cortical insufficiency is muscular weakness. The contraction curves from adynamic muscles resemble those obtained from muscles poisoned with iodo-acetic acid. According to Verzár, absence of cortical hormone, like iodo-acetic acid poisoning, affects the chemical processes of restitution in muscle which are associated with lactic acid formation. Numerous experiments are quoted showing the disturbance in lactic acid formation and in the whole carbohydrate metabolism. In adrenalectomized rats the disappearance of injected lactic acid is slowed down, the oxygen consumption and the carbon dioxide output are only slightly increased during exercise, which is attributed to impairment of lactic acid formation, there is only a slight increase in the lactic acid concentration of indirectly stimulated muscles, formation of glycogen is impaired, liver and muscle glycogen are low and the blood sugar, therefore, has a tendency to fall during exercise.

Verzár's analysis of these metabolic changes started by studying the absorption of sugars from the intestine. In adrenalectomized rats as well as after iodo-acetic acid poisoning, the selective absorption of glucose and galactose was found to be inhibited. The selective absorption is attributed to phosphorylation of these sugars in the intestinal epithelium, and the cortical hormone is to bring about this reaction not only in the intestinal epithelium but also generally in all cells. In this way the changes in the carbohydrate metabolism during cortical insufficiency are explained. The theory is further made responsible for explaining changes in salt and water metabolism. Phosphorylation is also thought to be the key to the changes in fat metabolism. In adrenalectomized animals and in iodo-acetic acid poisoning the development of fatty livers after different forms of treatment is prevented and the fat absorption from the intestine is inhibited. This is explained by inhibition of fat synthesis in the epithelium due to impairment of phosphorylation, in this case of the phosphatides.

Another interesting outlook is the relation of the action of the cortical hormone to enzymes and vitamins, particularly those of the B group. The respiratory enzyme of Warburg contains as prosthetic group vitamin B_2 (lactoflavin or riboflavin), which is phosphorylated and linked to the protein. According to Verzár the cortical hormone enables the phosphorylation to take place, and lack of cortin results in the inability of phosphorylating riboflavin. In adrenalectomized rats and in iodo-acetic acid poisoning the growth ceased; it could be restored by flavin phosphoric acid but not by riboflavin. In further experiments on adrenalectomized animals the ratio between free and bound lactoflavin was found to be reduced from 1 : 10 to 1 : 1. It is assumed that the phosphorylation of vitamin B_1 to cocarboxylase is also impaired during cortical insufficiency. Recent experiments, however, of Ochoa and Rossiter (*J. Physiol.*, 97, 1P.) "offer no evidence for the theory that the adrenal cortical hormone is necessary for the phosphorylation of vitamin B_1".

In the concluding chapter a diagrammatic representation is given of the changes occurring in cortical insufficiency to illustrate how they all, those of carbohydrate, fat, sodium, potassium and water metabolism, may be traced back to impairment of the one basal factor of cellular metabolism, phosphorylation.

We may be grateful to Verzár for having given us such a clear and detailed account of his attractive theory, the ultimate value of which remains to be decided by future experiments. His results have to be confirmed and new experiments carried out before the theory will be generally accepted.

W. FELDBERG.

ECONOMIC ENTOMOLOGY

Destructive and Useful Insects

Their Habits and Control. By Prof. C. L. Metcalf and W. P. Flint. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xvi+981. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 50*s*.

THIS second edition is a comprehensive work intended for the student of entomology as well as for the practical man in the agricultural or veterinary field. It is conveniently arranged to this end.

The first third of the book includes a generalized treatment of the importance of insects to man together with a simplified account of the morphology, physiology and development of these animals. The physiology of insects has been described as the handmaid of economic entomology, and one would have preferred this part to have been enlarged and brought into closer reference with the later economic sections. In these pages, too, is an account of the principles of insect control with the stress on practical rather than academic aspects.

The rest of the volume is concerned with accounts of some 370 pests—agricultural, veterinary and medical—and the practical man to whom these pages will appeal is provided with helpful keys and descriptions for their identification.

New features of value in this edition are the cross-references given to those insects whose damage lies in more directions than one, the keys for the identification of young as well as adult stages and the additional matter relating to modern aspects of chemical control.

The book contains a wealth of valuable practical information. Omissions are, however, inevitable. For example, the Aphidæ are credited with doing no more damage than that caused by robbing the host plants of fluid, and no mention is made of the conjunctivitis fly, *Hippelates pusio* of California, which is within the area covered by this book.

Following a discussion on page 161 on the need for scientific names instead of 'nicknames', it is remarkable that each species is recorded under its 'nickname' in bold type, the scientific name being relegated to a footnote and in some cases omitted altogether, as on p. 483.

The book is copiously illustrated by clear figures, though some of these have suffered in reproduction. It is carefully indexed and well printed and deserves a good reception, especially from all students of entomology in the United States and southern Canada, the area which it is intended to serve.

L. E.

MOLECULAR STRUCTURE AND RAMAN SPECTROSCOPY

The Raman Effect and its Chemical Applications
By James H. Hibben. With a Theoretical Discussion by James H. Hibben and Prof. Edward Teller. (American Chemical Society, Monograph Series, No. 80.) Pp. 544. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 66*s.* net.

MODERN students of molecular structure have before them the double objective of the determination of the positions and mobilities of the atoms in a molecule, or, in other words, the equilibrium atomic configuration and the intramolecular force field; and their ideal is to achieve a complete and quantitative description of these complementary features of structure. Two types of method of outstanding value are available for the quantitative study of atomic configuration, namely, a group of interferometric methods, either with electrons or X-rays, and a group of spectroscopic methods, which may be summarized under the name long-wave spectroscopy. One method only is available for the complementary study of intramolecular force fields, namely, the method of long-wave spectroscopy.

In long-wave spectroscopy the immediate object is to observe rotational and vibrational frequencies: the former are parameters for atomic configuration, the latter for both atomic configuration and intramolecular forces. Prior to 1928 the only direct method of observing such frequencies was by the study of absorption in the infra-red region of the spectrum, but with the recognition of the Raman effect, that is, that a rotating or vibrating molecule, when scattering light, may change its frequency by the frequency of the rotation or vibration, a second direct method became available. One advantage of the new method, its much simpler technique, was immediately appreciated, and observations of frequencies began to be added to the records at a rate never achieved by the method of infra-red spectroscopy.

As the theory of light scattering became better understood, it appeared that a second, and still more important, factor contributed to the value of Raman spectroscopy. For many molecules certain vibrations exist which cannot in principle record their fundamental frequencies in the infra-red spectrum. It is usually true for the same molecules that certain of their vibrations will not exhibit their fundamental frequencies in the Raman spectrum. However, the rules which govern the exclusion of frequencies from the two spectra are different, so that, by examination of both spectra, it may be possible to obtain a complete set of molecular vibration frequencies; and it will almost always be possible to obtain a more complete set than would have resulted from the application of either method separately: the two methods are complementary.

Dr. Hibben has now produced a book which may be regarded as a complete manual of Raman spectroscopy, alike from the points of view of experiment and theory. The work opens with a description of apparatus and a summary of all the information necessary to anyone who, without previous experience, wishes to make measurements. There follow four chapters, written in collaboration with Dr. E. Teller, on the theory of molecular vibrations and rotations, the theory of infra-red and of Raman spectra, of the vibrations and force systems characterizing molecules of particular types, and of factors such as isotopic substitution which modify spectra in predictable ways. This section is written with great clarity, and is, indeed, a striking example of the achievement of simplicity without loss of precision in a mathematico-physical subject. A good example of this is the product rule, which is derived and fully explained on a single page with the aid of only three formulæ. In the chapter on the vibrations of particular molecules, an effort seems to have been made to include all the formulæ likely to be useful to anyone wishing to calculate the force systems of simple molecules from the observed frequencies.

The chapter on isotopic substitution brings out the enormous advantage which this device confers on vibrational spectroscopy. Before 1935 there was no general method of passing rigorously from observations (frequencies) to ultimate conclusions (force fields) by the route

$$\text{Frequencies}\rightarrow\begin{cases}\text{Equilibrium configuration.}\\[6pt] \left.\begin{array}{l}\text{Vibration forms}\\ \text{(assigned to the}\\ \text{frequencies).}\end{array}\right\}\rightarrow\text{Force system,}\end{cases}$$

because, in the first place, there was no definite, quantitative test to confirm a configuration, and an assignment of its vibration forms, assumed as the interpretation of an observed set of frequencies; and, because, secondly, with a correct molecular model and a correct assignment, the number of frequencies was, for all but the very simplest molecules, smaller than the number of parameters needed to specify the force field. The method of isotopic substitution overcomes both difficulties, because the product rule, applied to the frequencies of isotopically related molecules, provides a test for any assumed model and any assignment of its vibration forms; and because by measuring the frequencies of a sufficient number of isotopically related molecules it is possible, in principle at least, to obtain a sufficient number of frequencies fully to specify the common force system.

The last three quarters of the book contain an exhaustive summary of the observations of Raman spectra over the whole field of organic and inorganic chemistry. Special points of physical or chemical significance are discussed in passing, and the text is illustrated with many interesting microphotometric traces of Raman spectra. These brief discussions will doubtless stimulate much research; indeed it is impossible to read five pages anywhere in this part of the book without wishing to investigate some question. A highly valuable feature is the bibliography and index of compounds, which together constitute a complete guide to the literature of the Raman effect. Heavy labour must have been expended on this compilation, but, writing so complete a work, the author has rendered a signal service to science, and to all interested in the subject of molecular vibrations.

C. K. Ingold.

HISTORY OF LIGHTING APPLIANCES

The Story of the Lamp (and the Candle)
By F. W. Robins. Pp. xiv + 156 + 28 plates. (London, New York and Toronto: Oxford University Press, 1939.) 15*s*. net.

It is surprising that such a commonplace subject as that of lighting appliances should be so poorly documented. There are plenty of references for those who have the time to find them, and there is always Hough's scholarly catalogue published some years ago as *Smithsonian Bulletin* No. 141. For the mechanical era, which title applies only to the last hundred years or so, there is a comprehensive account of earlier devices entitled "Chemical Technology", volumes 2 and 3, by Groves and Thorpe and published in 1895 by J. and A. Churchill, while for the present century information is not difficult to obtain.

In the volume under review, Mr. Robins has made an attempt to provide a treatise in which the subject shall be dealt with in some detail, and at the same time provide interesting reading as a narrative. The attempt has not been unsuccessful, although there are certain limitations such as the condensation of the final century, when illuminating power rose steeply, to a sketchy account of ten pages.

In the 5,000 years preceding Argand's invention of his doubly aerated burner, there was little improvement over the illuminating power of the lamps devised in Sumerian times; but of lamps, candles and torches there were so many forms and independent origins that it has taken a considerable degree of skill to weld the history into a readable form.

The author, in obtaining the material for his book, has acquired a noteworthy private collection, of which some five hundred items are illustrated in the twenty-seven plates. Errors of fact are few, but occasionally there is evidence of the inevitable pitfalls of over-compression normal to the presentation of such a wide subject. Thus on page 21, the author boldly refers to the first American discovery of petroleum as having occurred in the year 1859, when the Pennsylvania wells were opened, whereas d'Allion, writing in 1629, recorded its use medicinally by the Indians, and there were many other records in the intervening years.

In the "Prologue" the author expresses the hope that the book will be a substantial nucleus to which additions may be made, and in particular there is a reference to the ethnological significance of lighting developments which appears not fully to have been explored.

It is to be hoped that this treatise may provide the stimulus for a fuller investigation of the influence of the lamp and candle on contemporary developments, and that the work which Mr. Robins has begun will lead to extensive research in a field which is at present most inadequately explored.

W. T. O'D.

HISTORY OF THE VACUUM FLASK*

BY SIR WILLIAM BRAGG, O.M, K.B.E., PRES. R.S.

FEW laboratory devices have achieved the popularity of the vacuum flask. Since Sir James Dewar designed it for the purpose of preventing his liquid air from rapid evaporation, the flask has become a household friend and an invaluable tool in the laboratory and the workshop. It is so very simple and yet so very efficient. Each of the ways by which heat can pass from place to place, by convection, by conduction and by radiation, is almost entirely blocked, with the result that everyone knows.

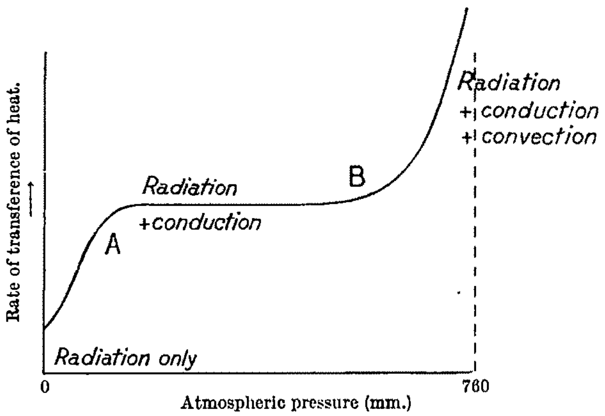

Fig. 1.

GENERAL FORM OF A CURVE SHOWING THE RELATION BETWEEN THE RATE OF TRANSFERENCE OF HEAT ACROSS AN AIR SPACE AND THE PRESSURE OF THE AIR.

Quite apart from the aptness of the design, the gradual discovery of the principles on which it is based makes a story of great interest. The pioneers in the study of heat believed that an examination of the methods by which heat is transferred would offer the best chances of discovering the nature of heat itself. Consequently their experiments were remarkable in themselves; and moreover, their interpretations of what they observed throw a curious light on the workings of their minds as they tried to establish one or other of the widely differing theories then held.

Thus Rumford in 1785 hung a thermometer by a thread in a closed vessel and set out to find whether or no heat was helped or hindered on its way to the thermometer by the air through which it must pass. He expected to find that removal of the air would hasten the transference of heat, because he believed that heat was associated with motion, and that the transference was effected by a wave motion in a medium which could not be evacuated. The air in his vessel would not on that theory be the actual carrier of the heat and might well be a hindrance. He formed a Torricellian vacuum in his vessel by first filling it with mercury, which was heated to drive off any attached air, and then draining it in the usual way. It then appeared that the transference was less rapid than when the vessel contained air at atmospheric pressure. This may not have been what he expected, but nevertheless it favoured his theory because it seemed to show that heat could cross a space void of air. As a matter of fact, there must have been enough air left to be important, but he could not have known that. His critics, whom we may take to be represented by Leslie—whose experiments will be described later—supposed that air was alone responsible for the transfer and refused to believe that heat could cross a vacuum.

As we know now, the relation between the flow of heat across any space and the pressure of the gas in that space can be represented by a curve of which the general form is shown in Fig. 1.

The positions of the bends at *A* and *B* and the dimensions of the curve depend on the form of the experimental vessel, the condition of its walls and the nature of the gas which it contains. If the emitting and the absorbing surfaces within a vessel are small compared with the dimensions of the vessel, convection will play a large part unless the pressure is small, and the bend at *B* will then be far to the left of the figure. If convection is not serious, a long level stretch from *B* to *A* will show that the conduction is independent of pressure—as Maxwell proved—until at *A* the free path of the molecules becomes comparable with the dimensions of the vessel. If evacuation passes this point, conduction rapidly ceases and radiation acts alone.

Rumford's vacuum was good enough to take him some way round the corner at *A*, but he could not have known how far he had yet to go. Air was still doing most of the work. He may perhaps have reduced the pressure to a tenth of a millimetre.

A little later (1798), Rumford carried out his famous experiment of the generation of heat during the boring of a cannon. About the same time he compared with great care the weight of a mass of water when hot and when cold and, finding no difference, placed the result to the credit of the 'motion' theory. The supporters of the theory that heat was a form of fluid were by no means impressed by all these arguments. Davy and Young supported him, but they were very much in the minority. Leslie was an energetic opponent. "In the infancy of science", wrote Leslie ("An Enquiry into the Nature of Heat", p. 139 (1804)), "heat was supposed to consist in certain intestine vibrations". He had not changed his mind when he wrote "Dissertation Fourth" prefixed to the seventh edition of the "Encyclopædia Britannica" (1830).

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* Substance of lectures at the Royal Institution delivered on December 7 and 14.

Leslie supposed that light traversed space in material form and entered into some kind of combination with the matter of any body on which it fell; in that way heat was produced. Heat itself, as such, could not cross a vacuum. The transfer of heat across an air space was accomplished through the simultaneous agencies of air pulses and of air jets directed from the hot body. Herschel in 1800 showed that a thermometer when placed in the spectrum and also when placed well outside the red end of the spectrum showed the receipt of heat without the agency of light. It was then asserted that his experimental arrangements were at fault. "This bold hypothesis was for a time regarded with wonder and applause but the delicate observations of Berard soon demolished the fabric. The notion of dark rays of light which enveloped the science in mystery stands now therefore without any proof and is utterly discountenanced by sound philosophy" ("Dissertation Fourth", p. 636). Herschel's own interpretation of his experiment is very interesting. He supposed that there were two forms of radiation, one constituting light and the other heat, and that they overlapped. "Those who would have the rays of heat do also the office of light must be obliged to maintain the following arbitrary and revolting proposition: viz., that a set of rays conveying heat should all at once in a certain part of the spectrum begin to give a small degree of light" (*Phil. Trans. Roy. Soc.*, **90**, 508). If this attitude seems surprising to us, we may well remember that we are less inclined in these days to consider our natural senses to be the perfect overriding judges of natural effects. Herschel would think that light and eyes were made for each other, that the intensity of light in different parts of the spectrum both as sensation and as cause of sensation was what the eye could see there, and that it was "revolting" to suppose that there was something of the same nature as light which the eye could not see.

Since Rumford made these first experiments, a number of workers have examined the passage of heat across a gas-filled space, not with Rumford's purpose of discovering whether air is necessary, but as tests of theories connecting amounts of transference with difference of temperature. Dulong and Petit did not use a high vacuum: they speak of 2 mm. mercury as being usual (*Ann. Chim. Phys.*, **7**, 245; 1817), so that their evacuation cannot have taken them round the corner at *A*. In 1875 Kundt and Warburg (*Pogg. Ann.*, **156**, 177; 1875) carried the experiment to the limit. They had good pumps and they cooked their containing vessels so as to drive off gases adhering to the walls, a procedure which they found to be absolutely necessary. As they arrived at the same figure for the transference no matter whether air, hydrogen or carbon dioxide had been in their vessel before evacuation, the last traces of gas must have been gone before the measurements were made. The remaining transference must have been due to radiation alone: in their case it was of the order of the fourth or the fifth of the amount when the vessel was full of gas, but of course this figure has no absolute meaning since it depends on the conditions of the experiment.

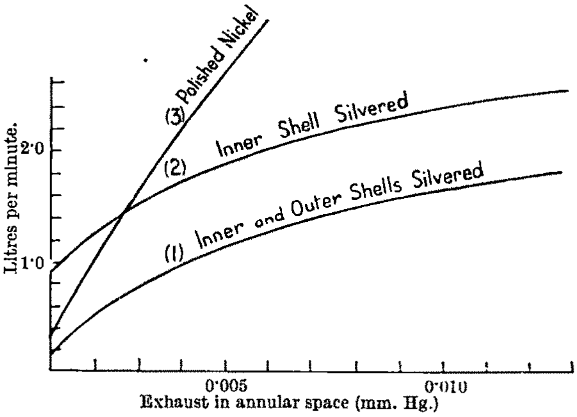

Fig. 2.

THIS FIGURE IS TAKEN FROM DEWAR'S PAPERS, VOL. 2, P. 1265. IT SHOWS THE RELATION BETWEEN THE AIR PRESSURE IN THE ANNULAR SPACE OF A VACUUM FLASK AND THE LEAKAGE OF HEAT MEASURED BY THE AMOUNT OF LIQUID AIR EVAPORATED FROM THE INNER VESSEL. THE AIR PRESSURE IS VERY LOW, SO THAT THE EFFECTS OF RADIATION ARE CLEARLY SHOWN.

When Dewar began to construct his vacuum vessels, he also found that the greatest care must be taken to remove the last traces of gas: very often the vessels had to be kept in the heated oven for many days.

The next feature of the vacuum flask to be considered is the silvering of the walls bordering on the evacuated space. In the early days, to which I have already referred, the connexion between the amount of radiation emitted or absorbed and the surface of the emitter or absorber was also a subject of interest, because, as already said, it might be expected to give information as to the nature of heat. Rumford and Leslie made experiments in this field, those of the latter being perhaps the best known. Their methods were similar, and their results also. Both used a 'thermoscope' resembling the earlier instrument which Leslie had made for his studies in hygrometry. Leslie's results were published in March 1804 in his "Inquiry into the Nature of Heat": Rumford's results were published in various places, some of them, for example, in the *Transactions of the Royal Society* in January 1804.

The two authors were probably unaware of each other's work and their publications may be considered to be simultaneous. Their interpretations were, of course, poles apart. Leslie supposed that metal surfaces reflected well, but emitted or absorbed badly because there was a layer of air in a special condition next all surfaces across which heat pulses could not pass, and that this was narrow in the case of non-metallic surfaces but wide in the case of metals unless the surface was roughened, in which case the peaks projected into the outer air. Rumford did not attempt such an intimate explanation, but merely recorded his results in terms of vibratory motion. He made one interesting mistake. He ascribed a definite frequency to each temperature, not in the modern sense that for each temperature there is a range of frequencies of which that existing in greatest intensity is characteristic of the temperature, but on the assumption that for each temperature there was one frequency only. When a hot body *A* radiated to a cold body *B*, the former emitted rays of a higher frequency which were "calorific" to *B* and *B* emitted rays of lower frequency which were "frigorific" to *A*. Rumford was further in error in supposing that fluids did not conduct heat; he was misled by the magnitude of the part played by convection and missed the relatively small part played by conduction in the experimental arrangements which he made. Dalton and others pointed out his mistake.

It will be remembered that Rumford discoursed widely on the consequences of the laws of heat displayed in natural phenomena. He discussed also the proper application of the laws to human activities, and it is not surprising to find him pointing out that if heat is to be prevented from passing between two vessels, one of them inside the other, it is well to silver the outside of the inner vessel and the inside of the outer ("Complete Works of Count Rumford", 2, 243). The same idea must have been put forward frequently when the main laws of heat were understood. For example, in a book written by Gompertz in 1850 (see letter by G. H. Gabb, *Daily Telegraph*, Oct. 12, 1935), a 'fireproof box' is described which is to consist of one metal box supported on springs within a second. The space between is to be evacuated of air to prevent conduction and convection, and the metals are to be well polished to prevent radiation. Probably the author of this idea never tried to carry it out, or he would have discovered the difficulties of construction.

Dewar was obliged to face those difficulties when during 1892–94 he was in urgent need of effective containers of liquid air. With characteristic drive and energy, he succeeded in obtaining all the vessels he wanted of many forms and sizes. One of the chief technical difficulties was naturally the join of the two vessels, inner and outer: it was difficult to get a join that could stand—as Dewar put it—"the torture to which the glass is put". A rubber cap was often provided if—in the case of the early vessels—it was necessary to pour the liquid air over the junction. The first vessels were made in London by Muller and by Gillingham: they were afterwards obtained in large quantities from Germany. Mr. George Gabb has told me that he helped Muller with some of the first silvering; and Mr. Gillingham has shown me some of the appreciative letters which Dewar wrote to him.

A very great improvement in the production and subsequent maintenance of the vacuum was made when Dewar made use of the absorbing power of charcoal. Dewar points out that Davy employed caustic potash to remove traces of carbonic acid left after his air pump had done its best: and further, that de Saussure in 1815 made an extensive examination of the absorbing powers of charcoal from different sources. Tait and Dewar used this effect in 1874; they found coconut charcoal to be the best. When large containers were required, especially during the War of 1914–18, it was necessary to make them of metal, as the mechanical strength of glass was insufficient. Without charcoal the vacuum in these vessels could not have been maintained.

Dewar made splendid use of his ingenious device. His experiments had a special directness, and some were of great beauty. It is so long since they were shown in the theatre of the Royal Institution that many may like to see them, either because they have not seen them before or because they remember when Dewar performed them. As the Institution still has the services of Mr. Green, who helped Sir James in much of his later work, it is possible to repeat them in good style, and I hope that this may be done shortly.

SOME BIOLOGICAL ASPECTS OF SOIL FERTILITY

BY PROF. W. NEILSON JONES

THE difficulties associated with their study have probably led to an under-estimation of the importance of the biological aspects of soil fertility compared with that of the purely physical and chemical factors. An outstanding difficulty is the impossibility of reproducing in pure cultures of soil organisms the conditions present naturally in the soil, and the danger of drawing deductions from such cultures as to what the behaviour of any organism will be in the soil, where it exists as a member of the mixed soil population in a continually shifting environment. Moreover, greatly as laboratory studies have advanced our knowledge of the processes of plant nutrition, they have usually failed to take full account of the complexities of the natural root environment engendered by the activities of various micro-organisms in the soil.

In the course of recent studies on the fertility of a particular soil*, methods of 'biological analysis' have been employed which are felt to be of considerable general interest in that they offer a new and promising means of experimental approach to certain aspects of soil fertility. These methods, which consist essentially in determination of the comparative reactions of the soil as a whole towards substances of known chemical composition or towards specific organisms, are yielding information as to the biological potentialities of different soils and as to the reactions taking place in them such as could not be obtained, it is believed, from study of soil organisms in pure culture alone.

The studies in question had their origin in an attempt to find a physiological basis for the behaviour of coniferous trees in certain areas of Wareham Forest, Dorset. But although these investigations have centred around the soil of this area, it should be clearly understood that this soil is not regarded as in any sense unique. It happens to be a rather extreme example of its type, and therefore specially favourable for study; but the same kind of reactions that are going on in Wareham soil intensively presumably occur in lesser degree in many soils. The phenomena associated with these soils are not of local interest only, but must be taken account of in any general study of soil biology or soil fertility.

A series of papers has already appeared bearing on Wareham Forest and describing the results of numerous experiments relating to this area[1]. It has been established that failure to make growth on the part of the trees, so strikingly apparent locally, cannot be attributed merely to poverty of nutrient salts, soil acidity, or other simple cause; and that the exceptionally good growth following upon application of certain organic composts cannot be ascribed to the available nutrients present in the compost dressing. The hypothesis was put forward that the local infertility on the area is due to toxic residues formed during decomposition of organic detritus by micro-organisms; and that the effect of the compost is to provide a substrate which, by altering the serial activities of the different soil micro-organisms, modifies the chain of reactions constituting humus decomposition; with the result that the final residues, instead of being toxic, are favourable to the growth of the trees, to the mycelial growth of the fungi associated with them as mycorrhiza-formers, and to the establishment and free-functioning of a normal and balanced mycorrhizal relationship.

It is proposed here to do no more than indicate the nature of the biological test methods employed which have served to establish the existence of soil toxins of biological origin. Experimental details must be sought in the papers to be published shortly.

Several independent lines of investigation have been followed.

(1) Observations of H. G. Morton have shown that a nutrient agar medium, buffered to pH 4·8, which develops a profuse growth of mycelium after infection from the air for a few moments, remains sterile indefinitely if spread as a thin film over Wareham soil. The conclusion is that something diffuses from the soil which inhibits fungal growth on the surface of the agar. (A standardized technique has been worked out by I. Levisohn in which chance infection from the air is replaced by inoculation from a pure culture.)

(2) Previous treatment of Wareham soil by heating, or with alcohol, etc., completely removes its inhibitory properties. This conforms to the view that the toxic substance is a product of some micro-biological activity in the soil.

(3) The toxic properties also disappear if the soil is allowed to dry out or is mixed with one of the composts alluded to above. Presumably these treatments provide conditions unfavourable to the toxic organism and/or favourable to other competing soil organisms.

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* Financed by the Agricultural Research Council.

(4) Toxic Wareham soil, partially sterilized to remove its toxicity, regains its toxicity in about ten days after inoculation with untreated soil. This is confirmation that toxicity is associated with the activity of some organism.

(5) Small weighed samples of cellulose may be recovered unchanged after being buried four months in Wareham soil; similar samples undergo considerable or complete decomposition in fertile woodland soil, or in Wareham soil to which compost has been added, as a consequence of fungal attack. The inhibitory action of Wareham soil thus extends to the fungi responsible for cellulose decomposition. There appears to be a direct correlation between rate of cellulose decomposition in a soil and its fertility as measured by tree growth.

To summarize: it has been shown by these methods that Wareham soil and soils like it contain a 'toxin' which inhibits growth of fungi such as air-borne moulds and mildews; some, at least, of the mycorrhiza-formers; and those responsible for cellulose decomposition in the soil. It has also been shown that this toxin results from the metabolic activity of some organism, such activity representing a course of humus decomposition largely absent in fertile soils.

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[1] Rayner, M. C., *Forestry*, 1934–39.

SURFACE TEMPERATURES OF THE STARS

THE abandonment of the 1939 British Association meeting at Dundee involved, among other things, the cancellation of what promised to be a discussion of great interest on the temperatures of stellar surfaces. Fortunately, however, Prof. W. M. H. Greaves's opening address on the subject appears in the October number of the *Observatory* magazine (62, 252; 1939). In his review of the present position, Prof. Greaves directs attention to the way in which recent observations—notably the colour temperature measurements carried out during the last ten years in England, Germany and France—have forced astrophysicists to the conclusion that no unique meaning can now be attached to the phrase 'the temperature of a star', because a stellar surface does not radiate even approximately as a black body.

The fundamental assumption of the early theory was that the total absorption coefficient of stellar material is not a function of the frequency of the radiation absorbed. The first deduction from this hypothesis is that the effective temperature of the radiation at any point in the star is equal to the temperature of the stellar matter at that point. From this in turn it follows that the star as a whole should behave very much as a black body, so far as its surface radiation is concerned; and on this conclusion is based the Fowler-Milne scale of ionization temperatures. But, unfortunately, the work on stellar colour temperatures developed at Greenwich, at Göttingen, and at Jungfraujoch leads to a totally different scale of temperatures. This disagreement between conclusions based on one hand upon direct experiment, and on the other upon an *ad hoc* hypothesis (for which little justification but mathematical convenience existed in the first place), has naturally proved fatal for the hypothesis.

The collapse of the assumption was not, however, entirely unexpected. The mere existence of discontinuities in stellar continua at the heads of absorption line series (notably at the Balmer limit) suggests that there is something seriously wrong with it. But in addition to this, the apparent breakdown of the Fowler-Milne scale of stellar temperatures has recently given an impetus to the mathematical investigation of various atoms with a view of determining if their absorption coefficients vary *between* the series limits. The work shows beyond doubt that such variation does exist, and it even predicts the type of variation for such simple atoms as those of hydrogen and the alkali metals. On the assumption that the absorption coefficient of hydrogen varies with the cube of the wave-length, Pannekoek (*Astrophys. J.*, 84, 481; 1936) finds that in an *A*0 star, where hydrogen is the main contributor to the spectrum, the colour temperature measured in the visual region should indeed be of the order of that observed, namely, nearly twice the effective temperature, simply as a result of this variation. At the lower temperatures of later-type stars, the more complex metallic atoms play a large part in the absorption; and beyond the qualitative result that the variation of metallic absorption coefficients with wave-length is in the opposite sense to the variation in hydrogen, little progress can yet be recorded in this direction.

Prof. Greaves concludes that future advances will call for contributions from the mathematician, in developing his treatment of the difficult general problem which allows for variability in the total absorption coefficient; from the physicist, in making laboratory measurements of the various atomic absorption coefficients; and from the astronomer, in devising and carrying out checks on theory as it develops.

A new method of obtaining the surface temperatures of stars directly from observation is announced by MM. Barbier and Chalonge in a paper following Prof. Greaves's address (*loc. cit.*, p. 273). These authors, recognizing the paucity of experimental information on atomic absorption coefficients, avoid their use altogether by dealing only with those early-type stars for which the total absorption coefficient is sufficiently great for the surface to radiate effectively as a black body. The criterion they use for selecting such stars is the size of the Balmer discontinuity: where this is large, the opacity below the Balmer limit will evidently be great. In this case there is a good chance that the radiation seen will originate mainly in the outer surface layers, the temperature of which will then be what is directly observed as the colour temperature of the star.

Evidence for this view is provided by observations of the eclipsing variable star Algol. The ultra-violet colour temperature of this star (which is typical, as to size of Balmer discontinuity, of the other stars considered) is found to be independent of the phase of the eclipse. Evidently the radiation from the centre of the disk is identical in composition with that from the limb (which is, of course, surface radiation). In this case, then, and by extension in the others also, the observed colour temperature is actually the effective temperature of the surface layers. The mean value for the A_0 stars selected is 12,500° K., which is in fair agreement with the ionization temperature.

This valuable method of attack thus brings still nearer the prospect of reconciling the various 'temperatures' which can be assigned to stellar surfaces. A. H.

OBITUARIES

The Earl of Crawford and Balcarres, K.T., F.R.S.

WE record with deep regret the death of the Earl of Crawford and Balcarres, which took place at Haigh Hall, Wigan, on March 8, at the age of sixty-eight years.

The Right Hon. Sir David Alexander Edward Lindsay was born on October 10, 1871, and succeeded his father in 1913 as twenty-seventh Earl of Crawford and as holder of other titles in the peerages of Scotland and the United Kingdom. He was educated at Eton and Magdalen College, Oxford, where he graduated in 1894 with first class honours in history. He afterwards entered upon a political career, and sat in the House of Commons, holding office on occasion, until he inherited the family titles. During the War of 1914–18 he served in France as a private and as a second lieutenant until in 1916 he was recalled to England to take up office as president of the Board of Agriculture and Fisheries. Later he held other offices in the Government, among them that of First Commissioner of Works, 1921–22.

Lord Crawford's interest in, and knowledge of, art and archæology were both widespread and profound; and in the performance of his duties as First Commissioner of Works, he was brought into close touch with conditions affecting archæological studies in Great Britain. Of this he made full and effective use both as president of the Society of Antiquaries and as a prominent figure in the various organizations which have had as their object the preservation of the antiquities, monuments and amenities of town and countryside in Great Britain. His charm and his personality, as well as his public experience and knowledge, made him an invaluable and most effective leader in any and every cause in which the interests of archæology were concerned, and it was owing very largely to his influence and persuasive powers that public and official interest in British antiquities was stimulated in post-War years to greater activity in archæological exploration and also in preserving such relics of the past as remain from an over-zealous desire for improvement or the inroads of commercialism.

Lord Crawford had already acquired a considerable reputation as a scholar in artistic and antiquarian studies, notably in the field of Italian art, before his official connexion with the Office of Works. He published his well-known "Evolution of Italian Sculpture" in 1910. He was a trustee of the National Gallery and the National Portrait Gallery, and in 1923 became a trustee of the British Museum. He was chairman of the Fine Art Commission and a member of the Royal Commissions on Historical Manuscripts and Ancient Monuments, as well as of the council of the British School of Archæology at Rome. His academic achievement and services to archæological studies were recognized by honorary degrees of the Universities of St. Andrews, Cambridge, Edinburgh and Manchester. Of the last-named University he was the chancellor, succeeding the late Lord Morley in 1923. As chancellor, he took a very keen and active interest in the affairs of the University. In the following year came his election as a fellow of the Royal Society.

Lord Crawford's death will be mourned on personal grounds by all who knew him; it is no less a serious loss to the cause of humane studies, and comes at a moment when so outstanding a personality can ill be spared.

Prof. F. P. Purvis

THE announcement of the death at Seaford, on February 20, of Prof. Frank Prior Purvis will be read with regret by all those interested in the progress of naval architecture, for he was the last surviving assistant of William Froude at the Admiralty Experimental Tank at Torquay.

Prof. Purvis was nearly ninety years of age, having been born on April 18, 1850. The son of Dr. Prior Purvis, he was educated at Blackheath School, and during 1867–70 was trained as a shipwright under the Admiralty at Deptford and Chatham Dockyards, and in the old Royal School of Naval Architecture and Marine Engineering at South Kensington. While passing through his training, he gained a Whitworth scholarship, being one of the first to do so. After a short time spent at the yard of Robert Napier on the Clyde, and on the staff of Sir Edward Reed, who in 1870 had resigned the post of chief constructor at the Admiralty, Purvis joined Froude at Torquay in 1871, and remained with him for six years. From Torquay he went to Govan, serving under Sir William Pearce, but in 1879 he became head of the scientific staff of Messrs. William Denny and Brothers, Dumbarton.

Froude had no greater admirer than William Denny III (1847–87), through whose initiative the firm constructed an experimental tank similar to, but slightly longer than, the Torquay Tank. This was the first tank to be erected by a shipbuilder, and the façade of it bears an inscription saying that it was erected in memory of Froude, "the Greatest of Experimenters and Investigators in Hydrodynamics". The first experiments were made in the tank in February 1883, and later tests proved of great value in the development of the designs for the cross-Channel vessels for which the firm is well known.

Leaving Dumbarton in 1889, for the next ten years Purvis was a partner in the firm of Blackwood and Gordon, Port Glasgow, and two years after severing his connexion with them he entered upon his long career of teaching in Japan.

The interesting story of the rise of engineering education in Japan dates back to the 'seventies of last century, when Dyer, Marshall, Alexander, Divers, Perry, Ewing, Ayrton, Milne and others went out from Great Britain to teach in the old College of Engineering (Kobu Daigakko), now a part of the Tokyo Imperial University, and when British naval engineers were lent to the Japanese Admiralty. Instruction in naval architecture was originally started in the College by the late Prof. S. Miyoshi, who had learnt shipbuilding under Robert Napier, but in 1899 the authorities invited Prof. P. A. Hillhouse to occupy the chair of naval architecture in the University, and it was his post to which Purvis succeeded in 1901.

Purvis held the chair for nineteen years, during which time, from a place of insignificance, Japan rose to be one of the chief shipbuilding countries in the world. From an output of about 3,000 tons in 1900, the tonnage launched rose year by year until in 1919 the output exceeded 600,000 tons. Early in the century, too, the Japanese Government built an experimental tank, 494 ft. long, at Nagasaki.

For his long services in Japan Purvis was decorated with the orders of the Rising Sun and Sacred Treasure. He was a member of the Institution of Civil Engineers, the Institution of Naval Architects and the Institution of Engineers and Shipbuilders of Scotland, to which he contributed a few papers.

The Rev. Hilderic Friend

THE REV. HILDERIC FRIEND died in his eighty-eighth year at his home in Solihull, Birmingham, after a long illness. He was born at High Wigsell in Kent in 1852, but spent his early years in the vicinity of Hastings and always regarded himself as a Sussex man. In 1874 he entered the Wesleyan College at Richmond to train for the ministry, and two years later he sailed as a missionary to China. Ill-health compelled him to return home in 1880 and, with a view to his recuperation, he was given a series of country circuits for his pastoral care. His first was at Newton Abbott in Devonshire, where he spent much time in the open air and began to study field botany systematically. Here he wrote "A Glossary of Devonshire Plant Names". This was succeeded in 1884 by "Flowers and Flower Lore" and by "The Ministry of Flowers" in 1885.

After travelling all over the country in his ministerial capacity, Mr. Friend retired in 1914. For many years he had interested himself in worms, and he now devoted his leisure to their more thorough study.

As the result of his labours science was enriched with the knowledge of many new species, and contributions from his pen have frequently appeared in the columns of NATURE. He was a voluminous writer, and was the author of more than a dozen books and of several thousand articles. In 1937 he successfully recovered from a serious operation, but a few weeks later his wife passed away. He never recovered from the blow. He died on February 7, leaving a son, Dr. J. A. Newton Friend, who is head of the Chemistry Department, Technical College, Birmingham, and a daughter.

WE regret to announce the following deaths:

Prof. W. C. Brøgger, rector of the University of Oslo and a foreign fellow of the Geological Society of London, on February 17, aged eighty-eight years.

Dr. R. T. Gunther, curator of the Oxford Museum for the History of Science, University reader in the history of science, on March 9, aged seventy years.

Prof. E. Maragliano, emeritus professor of clinical medicine in the University of Genoa, a pioneer in tuberculosis research, aged ninety-one years.

Prof. Károly Schaffer, emeritus professor of neurology and psychiatry in the University of Budapest, aged seventy-five years.

NEWS AND VIEWS

Phillippe de La Hire (1640–1718)

On March 18 the tercentenary occurs of the birth of Phillippe de La Hire, one of the most versatile of French men of science of the later half of the seventeenth century. The son of Laurent de La Hire, a famous painter, who died in 1656, he was instructed in art, but he also learnt mathematics from Gaspard Desargues, the friend of Pascal and Descartes. When twenty years of age, he went to Italy, where he spent four years. On returning to Paris, he resumed his mathematical studies and, during the next forty years, published many papers and books on geometry, conic sections, epicycloids, magic squares, and other subjects. His work on magic squares was based on the treatise of the fifteenth century Italian mathematician Emmanuel Moschopulus.

La Hire also, from 1683 onwards, made astronomical observations at the Paris Observatory, where the elder Cassini and Picard were similarly engaged, and with them, too, he carried out geodetical work for the map of France planned by Colbert. His physical work included researches on the variation of the compass, on refraction and barometric and thermometric measurements. He was elected a member of the Royal Academy of Sciences in 1678, and for a number of years held a chair in the Collège Royale de France. "Astronomer, mechanician, geometer, hydrographer," said Fontenelle, "he was an academy of sciences in one man". He was twice married and had eight children, of whom two, Gabriel-Phillippe (1677–1719) and Jean-Nicolas (1685–1727), were also members of the Academy of Sciences. La Hire died in Paris on April 21, 1718.

Jules Christian (1840-1907)

Dr. Jules Christian, an eminent French alienist, was born at Bischwiller in Alsace on March 16, 1840. He studied medicine at Strassburg, and for three years before graduating became a resident in the Stephansfeld Asylum (Bas-Rhin), which provided him with a rich field of psychiatric study. In 1863 he obtained the Esquirol Prize offered by the Société Médico-psychologique with an essay on the dura mater in the insane, and in the following year qualified with a thesis on hæmorrhagic pachymeningitis. During the Franco-Prussian War he took an active part in looking after the wounded, and after the peace of Frankfort in 1871 left his practice in Alsace and joined the staff of the Montevergnes Asylum in the Vaucluse Department, where he remained for nearly four years and made numerous contributions to the *Annales médico-psychologiques* and *Archives générales de médecine*, of which the most important were those on injuries in the insane, insanity following acute disease, and sensory changes in melancholia.

In 1876 Christian was appointed physician to the Maréville Asylum near Nancy, where he made a special study of general paralysis and epilepsy, and won the Falret Prize awarded by the Académie de Médecine by a work on epilepsy in relation to insanity. He also delivered a course of lectures at the time on mental disease, at the Nancy medical faculty, and would probably have been appointed professor in this subject, but in 1879 he was made physician to the asylum of Charenton, where he remained until his retirement in 1904. During this long period he made many more valuable contributions to the literature of mental disease, of which the chief were those on epilepsy and epileptic insanity, for which he gained a prize awarded by the Belgian Royal Academy of Medicine, and on dementia præcox. He died on July 11, 1907.

Countering the Magnetic Mine

According to the naval correspondent of *The Times*, a conspicuous feature of the *Queen Elizabeth* on her arrival at New York after her secret maiden voyage from the Clyde was a 'girdle' around her hull. This girdle is apparently the means of protection adopted against the magnetic mine. The girdle, supplied with electric current of the necessary strength and characteristics, sets up a magnetic field which, in association with the steel hull and other magnetic material of the ship, is such that magnetic mines laid at sea are not set off by the passage over them of a vessel so equipped. The apparatus is said to have been devised and developed by officers of one of H.M. naval establishments, with the advice and assistance of scientific men consulted for the purpose. It has been given the expressive name 'de-gaussing girdle', the aptness of which will be recognized by all with an elementary knowledge of magnetism.

Mr. Winston Churchill paid a tribute to this piece of work in his review of the war at sea when introducing the Navy Estimates in the House of Commons on February 27. He said, "We see our way to mastering the magnetic mine and other variants of the same idea. How this has been done is a detective story written in a language of its own . . . we do not feel at all outdone in science in this country by the Nazis." This is all the thanks which can be given at present for the work of some few of the men of science who have given up their investigations to put their special knowledge and skill at the service of the country. It is an achievement of high order to have devised protection against a relatively novel form of attack in so short a time, and should encourage the further use by the Government of scientific talent.

Blood Groups and Racial Diagnosis

In view of the stress laid by many anthropologists on the significance of the blood groups in the racial classification of man, attention may be directed to the results of certain investigations of the weak *A* reaction found in some cases of the group *AB* by G. L. Taylor,

R. R. Race, Aileen M. Prior and Elizabeth W. Ikin (*Brit. Med. J.*, Feb. 24, 1940). It had already been shown that in some *AB* cases the factor *B* is partially dominant to and obscures the *A* antigen; and that while there tends to be some weakening of the *B* reaction in group *AB*, it is nothing like so marked or so important as is the suppression of *A*. As there are two types of *A* antigen, A_1 and A_2, a stronger and a weaker, the suppression by *B* of an already weak A_2 in the group A_2B may result in it only being possible to detect the *A* factor with powerful anti-*A* serum, the cells otherwise being diagnosed as group *B*.

Following on the observations recorded, it is shown that the order of decreasing strength of reaction is A, A_1B, A_2, A_2B. Further, as the serum from quite a number of A_2B cases contains the antibody α_1, which reacts with A_1 but not with A_2 cells, unless appropriate measures are taken, a reaction will result which confirms the diagnosis of group *B*. In view of the significance attached in anthropological classification to the distribution both within a given population and geographically of the elements *A* and *B*, it is of interest and importance to note that cases diagnosed as *B* have been found on re-examination to belong to group *AB*, and an inspection of published figures from all parts of the world shows that in a large proportion of the series there is a real deficiency of the numbers in group *AB*. It is possible that herein lies a clue to the explanation of certain anomalies and apparent irregularities to be noted in studies of the groups as racial elements.

The Black Rat in Great Britain

NOT so long ago it was generally said that the black rat, *Rattus rattus*, had disappeared from Britain, ousted in unequal contest with the brown new-comer, *Rattus norvegicus*. But to most naturalists interested in the subject it was known that little centres existed in wide-scattered areas where a black rat could be found if it was wanted. Now Colin Matheson, in an interesting account of results derived from his own observations in Cardiff and from a *questionnaire* sent to medical officers of health in "approved ports", discloses a somewhat disturbing situation about the black rat, the carrier of the flea, which in its turn disseminates plague (*J. Anim. Ecol.*, 8, 76; 1939). Stringent regulations are in force to ensure that ships are kept free of rats, and that while ships are in port it should be made extremely difficult for inboard rats to make a passage to the shore. The result has been a general decline in the rat population of ships visiting Britain, although a number averaging 6–8 seems to be the irreducible minimum on rat-infested ships.

On shore, however, in spite of rat-weeks and rat-prevention measures, the number of black rats appears to be on the increase, the statistics for thirteen British seaports showing a rise from about 4,110 in 1929 to more than 6,437 in 1934 and 5,362 in 1937. Moreover, the shore companies appear to be extending their range from the neighbourhood of docks to city areas, in some of which they are well established, and are able to maintain themselves without further accessions from the dockyard immigrants. Of the three commonest races of the black rat the most frequent in British seaports is the typical black form, *R. r. rattus*, but curiously enough the brownish *R. r. alexandrinus* takes the lead in numbers in London and Plymouth.

Activities of Analytical Chemists

IN his presidential address to the Society of Public Analysts and other Analytical Chemists delivered on March 6, Prof. W. H. Roberts pointed out that there has been much less need in this War than in the last for the formation of *ad hoc* committees of chemists to deal with problems with which the Government departments found themselves faced, for much had been foreseen and provided for; and some of the departments had from the outset adopted the course of appointing to their staffs eminent outside chemists, who not only brought to the departments their own expert knowledge but also rendered the departments more accessible to suggestions and representations from outside chemical bodies. The compilation of the National Service Register by the Ministry of Labour, in which the Society had co-operated, had provided the Government with a source of specialized personnel. The conditions of appointment of gas identification officers needs reconsideration, especially in view of the duties now placed upon them in respect of preliminary food tests for gas-contamination. Referring to the Food and Drugs Act of 1938, Prof. Roberts said that the rationing of meat would probably lead to increased consumption of certain other foods, such as sausages and cheese, and regulations governing the content of meat in sausages and of water in cheese (particularly processed cheese) would therefore become very necessary.

The number of analysts and consultants in independent practice has diminished greatly in recent years, Prof. Roberts said, but in the public interest it is important that there should be a strong band of such chemists, not attached to any special interest, and it was therefore necessary to watch closely for cases of unfair competition by publicly supported laboratories. Speaking of the necessity of maintaining a high standard of efficiency amongst analysts, he expressed regret that no English university has yet inaugurated a chair of analytical chemistry, and also suggested that the universities should exercise more rigorous selection to ensure that only students having a real aptitude for the subject should be admitted to their courses. The roll of the Society now includes 886 names. The following officers for the year 1940–41 were elected: *President*, Dr. E. B. Hughes; *Hon. Treasurer*, G. Taylor; *Hon. Secretary*, Lewis Eynon.

The Ray Society

AT the annual general meeting of the Ray Society held on March 5, under the presidency of Sir Sidney Harmer, Lieut.-Colonel R. B. Seymour Sewell was elected a vice-president and Sir David Prain, Dr. R. W. T. Gunther (since deceased) and Mr. C. S. Todd new members of council. It was announced that the first volume of Prof. F. Balfour-Browne's "British Water Beetles" would shortly be issued to subscribers for 1939. The council, in its annual report, referred to the difficulties with which the Society is faced as a result of the War. The report continues : "The Council believe, however, that the work of the Society ought to be carried on as far as it is possible to do so in war time. In common with other scientific bodies, the Society has a definite function to perform in helping to maintain the continuity of our national life, of which its activities are a very small, but, as the Council believe, not a wholly negligible part. It is proposed therefore to go on with the publication of the works now being prepared, and the Council appeals to all members who are able to do so to continue their support of the Society."

Association of Scientific Workers: New Branch

THE recently formed Glasgow branch of the Association of Scientific Workers held its inaugural meeting in the Royal Technical College, Glasgow, on March 6. The proceedings opened with a display of films portraying the history of the vitamins and developments in the use of the cathode ray oscillograph. Dr. J. D. Sutherland, chairman of the branch, referred briefly to the aims and work of the Association and then called upon Prof. W. F. K. Wynne-Jones to deliver the inaugural address. Prof. Wynne-Jones led up to the general question of the organization of science and scientific workers by considering the planning of research. He said he is strongly opposed to the view that research should not be organized, and expressed the opinion that valuable results will only be obtained from an investigation if it is carefully planned beforehand. He contended that scientific research arises fundamentally from the needs of society, and illustrated his point with several very pertinent examples from the history of science. In furtherance of his argument for increased organization among scientific workers, Prof. Wynne-Jones spoke of the poor financial support received by research in Great Britain and of the muddles that had arisen at the outset of the War because men of science had not been called upon to organize services which belonged essentially to their province. Science can and must be organized, and to this end scientific workers must develop a corporate sense.

Rhodes Scholarships for India

THE Rhodes Trustees have decided to found two Rhodes Scholarships annually for India. The Rhodes Scholarships are of the annual value of £400, and tenable at the University of Oxford. With one or two exceptions they are awarded to young men who have been educated at universities in the British Dominions or in the United States of America. Cecil Rhodes laid down in his will that in the election of a scholar special regard should be paid to his scholastic attainments. his fondness for manly outdoor sports, his qualities of manhood, truth, courage, devotion to duty, unselfishness and sympathy for the weak, and his powers of leadership. The Rhodes Trustees are confident that candidates fully up to the high standard set by previous Rhodes Scholars will be forthcoming from India, and they have been assured that Indian Rhodes Scholars will be welcome at Oxford. These scholarships are founded for an initial period of five years, after which they will be reviewed in the light of experience. The first Indian Rhodes Scholars will go into residence at Oxford after the end of the War. This is the second announcement of post-graduate awards for Indian students which have been made in recent years ; it will be recalled that the Commissioners of the Exhibition of 1851 instituted exhibitions for India in 1937.

The Conception of the Atomic Clock

THE presidential address to the Section of Physics of the American Association for the Advancement of Science, which was delivered at Columbus on December 29 by Dr. Herbert E. Ives, is printed in *Science* (91, 79 ; 1940). The address is entitled "The Measurement of Velocity with Atomic Clocks". Taking the variation of atomic clock rate as an experimental fact, established by the Doppler effect in hydrogen canal rays, and adopting also the Fitzgerald contraction of moving rods indicated by the Michelson-Morley experiment, Dr. Ives points out that it is possible to define 'velocity' in various ways, none of which has any *a priori* claim to be chosen as 'correct'. The Restricted Theory of Relativity corresponds to the choice of one of them. "They are all deviations from the simple Newtonian concept of velocity", says Dr. Ives, "which is in terms of rods and clocks which are unaffected by motion. I urge the merit of the Newtonian framework as the only unambiguous basis for the idea of velocity". Dr. Ives does not consider that the ether has been "abolished" simply because it is possible to define velocity in a manner which makes it unnecessary to refer to that medium : he claims that the Sagnac experiment, in which beams of light moving in opposite directions round a rotating disk produce movable interference fringes, gives experimental evidence of the existence of the ether. His views, he says, "will be recognised as those of the earlier students of the subject—Fitzgerald, Larmor, Lorentz—but not of those who would shift the burden from variant measuring instruments to the nature of space and time".

Relativists will probably not be convinced by Dr. Ives's arguments. They will ask why, if there are invariant measuring rods and clocks, we cannot discover them but have to use those which vary with motion ; and further, why, of varying ones, we cannot tell in what state they approximate most closely to those which are immutable. It is to be noted also that Dr. Ives's address scarcely justifies the choice of title. An atom may be *conceived* as a clock, but cannot possibly be used as an instrument for measuring time or velocity unless we make an *ad hoc* definition of velocity in terms of wave-length changes and define an atom as a light-wave.

Treasure of Psusennes

Now that the sarcophagus of Pharaoh Psusennes found on the site of the ancient Tanis (NATURE, February 24, p. 300; March 9, p. 382) has been emptied of its mummy and associated jewellery, it has been possible to form a more just estimate of the magnitude of the find. It is regarded as one of the richest discoveries ever made after that of the tomb of Tutankhamen (*The Times*, March 7). In this collection of remarkably beautiful jewellery, some of the necklaces, as described, are outstanding. One, for example, is composed of two heavy bars of gold supporting a centre-piece in the form of a golden lotus, which is so heavy, it is said, as to emit a gong-like note when the necklace is shaken. Another necklace consists of several huge pieces of lapis lazuli with gold clasps, on which there is an inscription saying that the King had had made for him a necklace which never would be equalled. This necklace scales the remarkable weight of 12 lb. Among other objects of jewellery in the find are mentioned further necklaces, two bracelets, golden slippers with a golden case, pins and studs. All the antiquities found, with the exception of the granite sarcophagus, are being transferred to the Cairo Museum, where they will be placed on exhibition forthwith.

Meteorology in British East Africa

THE director of the British East African Meteorological Service, Mr. A. Walter, describes the work achieved by his Service in 1938 in his annual report for that year. Although described by him as an extremely difficult year, no hint of this would be obtained from a consideration only of the work achieved and the preparations made for extending and improving the activities of future years. Many of the staff fell sick because it had been impracticable for them to take the vacation leave to which they were entitled, and the training of all grades of staff had to be maintained; it was estimated that this would have to be continued for another five years before each section of the Service could become a fully efficient and self-contained unit.

There is much of interest both on the climatological and synoptic sides in this report, and evidence that important contributions to the understanding of meteorological processes are being made. During the course of the year the whole region, which includes Kenya, Tanganyika, Uganda and Zanzibar, has been divided up into zones characterized by peculiarities in the seasonal distribution of rainfall. Seven such zones were found sufficient to cover broadly the observed range of variation, and have been made the basis of a division of the country into forecast areas, which are shown on a map (p. 27). Both daily and weekly forecasts have been appreciated by the resident population and by visitors, an evidence of this interest being the suggestions received for increasing their frequency and extending their range. The weekly forecasts are based mainly on the relative positions of the high- and low-pressure systems on either side of the tropics and the probable changes in the main wind currents connected with them. They are described as an unqualified success, a fact which is modestly explained as being due to the circumstance that the effects of high or low pressure appearing off the west coast of Africa are generally felt about a week later in the tropical regions of East Africa.

Many planters have stated that their work is planned in accordance with the indications of the weekly forecasts. Local eccentricities of response to general changes are, however, an obstacle to accurate forecasting here as elsewhere, and it is stated (p. 25) that small short-period variations of pressure, temperature and upper winds are showing a significance which would be considered out of all proportion to their magnitude and duration in the meteorology of temperate regions. This report deserves to be regarded as a model for a young progressive meteorological service in the tropics.

Suggested Grid in the United States

CONFERENCES have recently been taking place in Washington with the officials of some fifty large public utility companies operating in the eastern part of the United States to explore the possibilities of constructing a series of high-voltage lines interconnecting the larger generating plants and power-consuming centres in this area, including both private and public developments. According to the *Electrical Review* of February 9, although up to the present no definite plan has actually been made public, the proposals include connecting links that would make it possible to interchange power whenever necessary between such major load centres as Boston, New York, Philadelphia, Washington, Buffalo, Cleveland, Detroit, Chicago, St. Louis, and possibly Birmingham. Connexions would be made with all major generating stations, both steam and hydro-electric, without regard to whether they are controlled by private capital, municipalities, or the Federal Government.

According to preliminary estimates, the construction would cost approximately £100,000,000. Objections to the plan have been raised owing to the ample generating capacity now in existence or under construction in each of the localities to meet possible future demands. It is also contended that the expenditure of such a large amount would impose an unnecessary financial burden upon consumers of electricity. The advocates of the scheme take the view that the future growth of power demand will be at an accelerating rate and that the rate of construction can be adjusted to actual needs for the new facilities. They are also understood to be relying strongly on the national defence argument, on the assumption that, even though temporarily uneconomic, the Grid can be justified as a safeguard against the power shortages experienced by American industry during the War of 1914–18.

New Radio Transmitter

ALMOST unnoticed in the unsettled international atmosphere that existed last August, an extraordinary radio transmitter was inaugurated in the pocket republic of Andorra, which bestrides a small section of the Pyrenees on the frontier between France and Spain. A brief account of this station is given in the *Electrician* of March 8. The President of the French Republic (as successor to the Kings of France) and the Bishop of Urgel in Spain share as co-princes the over-lordship of Andorra, a condition which has lasted since the early part of the ninth century. Radio Andorra is situated on a rocky hill at an altitude of 2,920 ft. above sea-level, but its aerial is placed at an altitude 2,460 ft. higher and is suspended across a lake; the supports, 410 ft. high, are 820 ft. apart. The feeder cable between the station and the aerial is 2,788 ft. long and is believed to be the only case in which a distance of this order separates a transmitter and its antenna, with the exception of the Eiffel Tower, where ultra-short waves had to be considered. At Andorra transmitters for medium and short waves are installed. The energy required for the station is 350 kilowatts and is obtained from the Forces Hydro-électriques de l'Andorra, a water-power undertaking, which sells the bulk of its production outside the borders of this small State.

Illness in Meat Packing Industry

IN a recent paper (*Public Health Rep.*, 54, 2196; 1939) Hugh P. Brinton, assistant statistician, Harry E. Seiffert, assistant public health engineer, and Elizabeth S. Frasier, junior statistician, United States Public Health Service, present an analysis of cases of sickness and non-industrial injuries lasting eight calendar days or longer among workers in the slaughter and meat-packing industry. The annual number of cases per 1,000 was 95·0 for white males, 144·2 for white females, and 137·9 for negro males, while the average number of days of disability per person was 3·16, 4·85 and 4·01 respectively. Those who showed the highest figures in the form of an excess of respiratory diseases were cold-meat workers among white males, scalers, wrappers and packers among white females, and by-product workers among negro males.

Very excessive rates for rheumatic diseases were found in certain occupations, especially those of warm- and cold-meat workers, sausage and casing workers, and curing workers. As regards environmental conditions, white males exposed to high humidity or wet had the highest rates, with non-respiratory and non-digestive diseases most in excess. Among white and negro males the highest incidence was found among those working in hides and wool, or glue and entrails, among whom digestive diseases were much commoner than the average. White males and white females showed sickness-rates in decreasing order of magnitude as follows: semi-skilled workers in manufacturing, labourers, and clinical workers.

New Seismographic Equipment in the United States

A NEW seismograph station has been established at Lincoln, Nebraska, and new equipment has been installed at Chicago, Salt Lake City, and Bozeman, Montana, all co-operating stations of the United States Coast and Geodetic Survey, according to J. H. Nelson and H. E. McComb. The new seismograph station is on the campus of the Nebraska Wesleyan University in Lincoln, Nebraska, and is situated on a layer of loess and glacial clay 150–175 ft. thick, under which is several hundred feet of Cretaceous sandstone. The position is latitude 40° 49·1′ N., longitude 96° 42·2′ W., altitude 358 ± 5 metres.

The seismograph operates as an east-west component and is a small experimental McComb-Romberg tilt-compensation seismometer having magnetic damping and a clock-driven completely enclosed recorder. Time control is furnished by a Seth Thomas pendulum clock compared daily with naval radio time signals from Arlington. Tilt compensating instruments have been installed at Chicago on account of the slow irregular tilt movements of the pier on which the seismographs rest. Salt Lake City (latitude 40° 45·9′ N., longitude 111° 50·9′ W., altitude 1433 ± 5 metres) had a two-component 100-kgm. Bosch-Omori seismograph and has recently installed a two-component small model McComb-Romberg tilt-compensation seismograph. At Bozeman, oil damping has been replaced by magnetic damping and the recording equipment has been improved.

Smoke Abatement

THE National Smoke Abatement Society has issued its quarterly, *Smokeless Air*, on a reduced scale but with a supplement "Smoke Abatement in War Time". This is an effort to rebut the belief that reduction of smoke under present conditions is unimportant. The impression that smoke serves a useful purpose by screening towns against air attack is challenged. A smoke screen may assist a moving object such as a ship, but serves as a landmark fixing the position of a stationary group such as a town. It may provide a screen to hinder the recognition of a specific object, but equally it conceals the attacker from the defence. Concealment is a great help to the submarine, and recent experience shows its assistance to raiding aircraft. The pamphlet directs attention to the way in which colliery tips serve as landmarks, providing a "difficult problem" in smoke abatement. The difficulty, it may be indicated, is less technical than political and due to the fact that the disposal of pit refuse is left to the discretion of the individual colliery. Naturally the cheapest possible method is used, regardless of the effect on the surrounding people, land and of the ultimate cost to the community. The chemical composition of pit refuse is such that self-ignition can scarcely be prevented when it is dumped in enormous heaps. Too often collieries are surrounded by low-lying land reduced to valueless swamp by mining subsidence. Pit refuse would serve a useful purpose, if used to raise the level of such land, and under such conditions firing would not occur.

Smoke results from the liberation of the volatile matter of coal, a large part of which is liquid. Smoke abatement is a movement for collecting this liquid for useful purposes instead of dispersing it as a public nuisance. Present conditions emphasize the wisdom of smoke abatement as a national defence measure. The national need for liquid fuel cannot, it is true, be met by the carbonization of coal, but the contribution is already by no means negligible. Already in 1938, 8 per cent of the motor spirit consumed in Great Britain was obtained from coal. The quantity of heavier oil suitable as fuel was of the same order. The pamphlet makes a plea for a planned fuel policy, saying that "smoke is a by-product of the technologically primitive phase of industrial civilization from which we have not yet emerged".

The Cooper Union

THE eightieth annual report of the Cooper Union for the Advancement of Science and Art covers the year ended June 30, 1939 (Pp. 122. New York, 1939). The report of the Director, emphasizing the extent to which industry is becoming more scientific, refers to the increase in basic instruction in science and mathematics in the engineering schools, and decreased instruction in detailed applications of engineering. Special stress is laid in this report on the integrated study of the social sciences, so as to develop the mind of the engineering student not only to think rationally and scientifically, but also to be able to grasp concepts that do not admit of the precise analysis, calculation and control with which the physical scientist and engineer have been accustomed to work and which have hitherto been the accepted limit of his knowledge and proficiency.

The Director considers that humanistic studies should be required throughout the four or five years of undergraduate training. Commenting on our failure to stir those interests which lead the engineering graduate to continuing his studies of science and society, he urges that the impasse which faces civilization to-day is due to our attacking our problem by rule of thumb, expediency and self-interest, instead of by the scientific method, which, if coupled with sensitivity to the human values of freedom and individuality, will save civilization from the irresponsible technologist and the scheming politician.

Control of Spirit

FOLLOWING the introduction of prohibition in Bombay, the Government has restricted sales, advertising and general dealing in all spirituous preparations containing more than 2 per cent by volume of alcohol. Recently, however, the Bombay Government has entirely exempted all toilet and cosmetic preparations containing alcohol from the prohibition regulations. It has also set up a Classification Committee to decide whether preparations which contain more than 2 per cent of alcohol can be used as beverages or not.

Non-Ferrous Metallic Ores

THE Minister of Supply has appointed a departmental committee to consider whether an increased production of non-ferrous metallic ores in the United Kingdom is desirable and practicable, and to make recommendations. The members of the committee are: Sir William Larke (chairman), Dr. C. G. Cullis, Mr. Arthur Deakin, Mr. J. Stanley Holmes, M.P., and Mr. S. S. Taylor. Prof. J. A. S. Ritson, Mr. T. Eastwood, and Dr. M. Macgregor will act as assessors to the committee. The secretary of the committee, to whom all communications should be addressed, is Mr. W. C. C. Rose, Geological Survey of Great Britain, Exhibition Road, South Kensington, London, S.W.7.

Colonial Appointments

THE following appointments and promotions in the Colonial Service have recently been made: H. K. Littlewood, veterinary officer, Nigeria; R. R. Temple, veterinary officer, Tanganyika Territory; C. L. Skidmore, agricultural superintendent, senior agricultural superintendent, Gold Coast; Dr. F. Dixey, director of geological survey, Nyasaland, director, Water Development Department, Northern Rhodesia; H. R. Binns, formerly veterinary officer, Nyasaland, veterinary research officer, Palestine; R. Leach, mycologist, Nyasaland, plant pathologist, Jamaica (temporary).

Announcements

THE tenth Joule Memorial Lecture will be delivered before the Manchester Literary and Philosophical Society by Prof. James Chadwick, professor of physics in the University of Liverpool, on March 19 at 5.30. His subject will be "New Applications of Physics to Medicine".

PROF. F. L. WARREN, formerly of the Fuad I University, Cairo, has been appointed professor of chemistry in the Natal University College, Pietermaritzburg.

THE fourth International Congress of Malaria will be held in Rome on the occasion of the International Exhibition of 1942.

THE Australian Commonwealth Government has set up a Central Medical Co-administrative Committee at the seat of Government at Canberra. The Committee will control all drugs and medical equipment so as to ensure the best use for the armed forces and civil population during war-time.

THE milk in schools scheme has been resumed for all children of school age, especially those in London. Voluntary milk clubs are being organized by teachers at schools and at certain other premises where children attend for some form of instruction. More than 200 of these clubs have already been formed and the number is growing almost daily. As in peace time, all children are asked to pay ½*d.* for each half pint of milk.

IN the article entitled "Food Production and Food Control" by Sir John Orr published in NATURE of March 9, p. 374, col. 2, last line of par. 3, the phrase "10 and 20 per cent" should read "5 and 10 per cent". This correction was received during the printing-off of the journal and was made in a part of the issue only.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 429. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Molecular Structure of the Collagen Fibres

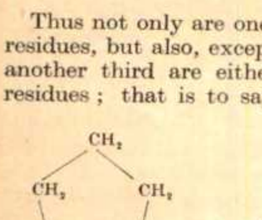
X-RAY studies of the fibrous proteins indicate that they fall almost exclusively into one or other of two main configurational groups, the keratin-myosin group and the collagen group[1]. The interpretation of the structure and properties of the former group is now well advanced and has frequently been reported on in NATURE and elsewhere, but the structure of the latter, in spite of many investigations, has hitherto remained unexplained. It was suggested several years ago that the amino-acid residues in gelatin (which also gives the typical collagen diffraction pattern) are somehow grouped in threes with probably every third a glycine residue and every ninth a hydroxyproline residue, that the strong meridian arc of spacing about 2·86 A. is associated with the average length of a residue in the direction of the fibre axis, and that such an average length could very well arise from an alternate *cis*- and *trans*-configuration[2]; but further progress was not possible for lack of experimental data. More recent chemical and X-ray evidence points now to a solution that is both simple and convincing.

(1) Bergmann[3] concludes that the average residue weight in gelatin is about 94, and that the chief residues are present in the proportions set out in the accompanying table:

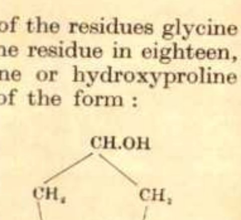
AMINO-ACID FREQUENCIES IN GELATIN

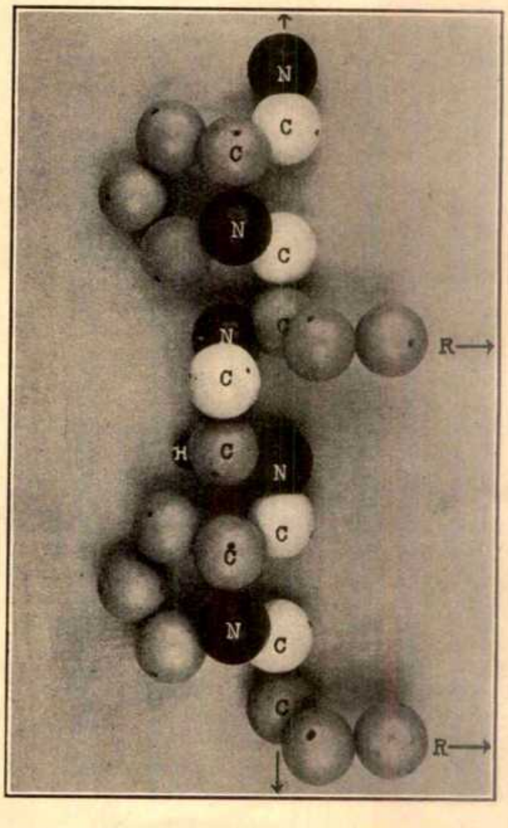
Amino-acid	Wt. %	Mol. Wt.	Gm. Mol.	Frequency
Glycine ..	25·5	75	0·34	3 $(2^0 \cdot 3^1)$
Proline ..	19·7	115	0·17	6 $(2^1 \cdot 3^1)$
Hydroxyproline	14·4	131	0·11	9 $(2^0 \cdot 3^2)$
Alanine ..	8·7	89	0·098	9 $(2^0 \cdot 3^2)$
Arginine ..	9·1	174	0·052	18 $(2^1 \cdot 3^2)$
Leucine-*iso*leucine ..	7·1	131	0·054	18 $(2^1 \cdot 3^2)$
Lysine ..	5·9	146	0·040	24 $(2^3 \cdot 3^1)$

Thus not only are one third of the residues glycine residues, but also, except for one residue in eighteen, another third are either proline or hydroxyproline residues; that is to say, are of the form:



or





The table shows too that there cannot be fewer than 72 residues in the gelatin 'molecule' (there will not be any definite molecule of gelatin itself, but only large, and possibly somewhat modified, fragments of the original collagen pattern): the true number must be a fairly high multiple of this, possibly 576, to judge by the histidine content for example.

(2) The side-chain and backbone spacings in dry gelatin are about 10·4 A. and 4·4 A., respectively, while the density is about 1·32 gm./c.c. Suppose these two spacings to be inclined at an angle β, and the average length of a residue in the direction of the fibre axis to be *L* A., then

$$94 \times 1{\cdot}65 = \frac{10{\cdot}4 \times 4{\cdot}4 \times L \times 1{\cdot}32}{\sin \beta}$$

that is, $L = 2{\cdot}6 \sin \beta$ (approx.),

and therefore *L* cannot be greater than about 2·6 A. This is only an approximate calculation, but it is sufficiently accurate to confirm that the strong meridian arc of spacing 2·86 A. is almost certainly associated with the average length of a residue.

(3) If it is actually equal to it, as seems most probable, and the residues follow one another in a row, then from the table the minimum length of the intramolecular pattern along the fibre axis is about 72 × 2·86 A. This length is not only too small to include the residues of other acids, such as histidine, omitted from the table, but also it is too small to account for the meridian spacings reported by Wyckoff and Corey[4] and by Clark and co-workers[5]. Their data are best explained by a sequence of 4 × 72 residues in a row, grouped in approximate sets of 12, 24 and 36. This gives a molecular weight of about 27,000, or a multiple thereof, corresponding to Svedberg's gliadin class[6].

(4) The proposed partial *cis*-configuration[2] is readily accounted for by the preponderance of imino residues. When we allow for this and the glycine content, there seems to be only one reasonable solution, represented by the scale model shown in the accompanying illustration. The basic sequence is *–P–G–R–*, where (with the exception of one residue in eighteen) *P* stands for either proline or hydroxyproline, *G* for glycine, and *R* for one or other of the remaining residues. The full-length pattern, and also variations within the collagen group as a whole, must arise by suitably modifying this simple theme.

Using the interatomic distances found in silk fibroin, the average length per residue in the pattern shown in the illustration works out to be 2·85 A., almost exactly the spacing of the strong meridian arc. Other points in favour of the model are: (*a*) there is no steric interference between the side-chains, the longer side-chains all lying on the side of the main-chain remote from the rings, leaving only the unobtrusive glycine side-chain (*–H*) on the same side as the rings; and (*b*) the polypeptide chain proceeds in a straight line, and any attempt to stretch it results in the side-chain (*–R*) swinging over towards the rings and the system coiling back upon itself: thus we have an explanation of the paradox that though the collagen configuration is shorter than that of the β-proteins, it is nevertheless practically inextensible.

The above solution of the collagen problem permits now of the broad generalization that all the extended forms of the fibrous proteins fall into either of two classes: they are built from polypeptide chains in either the *cis*- or the *trans*-configuration.

A fuller account of this investigation may be found in the first Procter Memorial Lecture[7], and a more detailed discussion still will be published elsewhere.

W. T. ASTBURY.
FLORENCE O. BELL.

Textile Physics Laboratory,
University of Leeds.
Jan. 31.

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Capture Cross-Sections for Thermal Neutrons in Thorium, Lead and Uranium 238

EXPERIMENTS on the processes arising in thorium under neutron bombardment have shown that nuclear fission is induced only by fast neutrons of energies of about 2 Mev. or more. There exists also a radiative capture process producing an isotope of thorium (Th 233) of 26 min. half-life; this process has a resonance character with a large contribution from thermal neutrons[1]. So far, the capture cross-section of thermal neutrons in thorium has not been measured. The following experiments were carried out in order to determine this cross-section.

As the neutron source available was not very strong (100 mgm. Ra + Be), all dimensions had to be kept as small as possible. On the other hand, in order to obtain high accuracy of measurement, one had to use an absorbing thorium layer of reasonable thickness. By the kindness of Prof. Coster, I obtained a sample of metallic thorium of more than 99 per cent purity. Dysprosium of the highest purity, also kindly given me by Prof. Coster, was used as detector. The thorium was almost exactly prismatic in form (1·2 cm. × 1·2 cm. × 2·96 cm.). The dysprosium was a thin layer (15·7 mgm./cm.^{2} Dy) of rectangular form, 1·0 cm. × 2·7 cm., and its upper face was covered with 2 μ 'Cellophane'. For the absorption measurement the thorium was placed directly on the dysprosium with or without a cadmium screen, so that the neutrons impinging normally had to go through 1·2 cm. thickness corresponding to 13·4 gm. thorium.

The experimental arrangement was as follows. In a plate of paraffin wax of 3·8 cm. thickness, there was cut out a rectangular cavity of 1·3 cm. depth, the bottom and sides of which were covered with cadmium of 0·5 mm. thickness so that thermal neutrons could not enter except from above. This plate was put between two other plates of paraffin wax, forming in this way a block of 11·5 cm. height and about 25 cm. × 25 cm. area. The dysprosium was placed on the cadmium-shielded bottom of the cavity. The upper paraffin plate contained the neutron source 3·3 cm. below the surface in such a way that the source just touched the upper edges of the cadmium screened cavity.

The activity of the dysprosium detector was measured with a Geiger-Müller counter with 0·1 mm. aluminium walls connected to an amplifier. The dysprosium, the half-life of which was carefully determined and found to be 156 ± 3 min., was in all experiments irradiated up to saturation, and the decay of the activity was followed for several hours in order to increase the accuracy of measurements. All measurements were referred to a uranium standard. The contribution from thermal neutrons was determined by carrying out the irradiation with and without 0·5 mm. cadmium directly over the exposed face of the detector. With cadmium screens on all faces of the detector, the observed activity is due to neutrons faster than thermal neutrons. Under the experimental conditions used here, it amounted to 9 per cent of the activity obtained without cadmium on the exposed face.

For the determination of the capture cross-section for thermal neutrons in thorium, one has to consider the different kinds of interaction of neutrons with the thorium nucleus. The fission cross-section of fast neutrons is so small as to be negligible. The same holds for the radiative capture cross-section of fast neutrons. Therefore for fast neutrons one has to take into account the scattering cross-section only. Because of the arrangement used—the absorber being put directly on a detector of nearly equal size—one would expect that practically all the scattered neutrons would be efficient in the irradiation, that is, the scattering cross-section would not enter into these measurements. Experiment confirmed this expectation. When the detector was screened on both faces by cadmium, the measurements of the activity with and without thorium (or with and without lead) gave the same values within the experimental error of 2–3 per cent. Further, in order to test the influence of inelastic scattering, the cadmium was placed by turns either directly on the exposed face of the detector (with the thorium put upon that), or between the neutron source and the thorium absorber. No difference could be detected. Thus the inelastic scattering does not give rise to thermal neutrons in any observable quantity, a result to be expected.

These results suggest that, under the conditions actually used, the scattering of thermal neutrons too will be negligible, and thus the decrease in activity (of about 28 per cent) caused by the thorium absorber is due to radiative capture processes only. To obtain a direct proof the absorption in metallic lead was measured. The lead absorber had practically the same dimensions as the thorium absorber, but the thickness of the cast lead prism of density 10·6 was kept a little smaller (1·10 cm.) in order to have the same number of absorbing nuclei per cm.^{2}.

Of course, in determining the cross-sections, the angular distribution of the thermal neutrons was taken into account and obliquity corrections (angles up to nearly 70° were involved) were made according to the data given by Frisch[2].

The total cross-section for thermal neutrons in lead was found to be $\sigma^{th}_{\mathrm{Pb}} = 2{\cdot}5 \pm 0{\cdot}2 \times 10^{-24}$ cm.^{2}. This value is in very good agreement with the value of $2{\cdot}3 \times 10^{-24}$ cm.^{2} obtained by Fleischmann[3] from γ-ray measurements. Thus one can be sure that for thorium too the radiative capture cross-section alone enters into the measurements. The value obtained is $\sigma^{th}_{\mathrm{Th}} = 6{\cdot}0 \pm 0{\cdot}3 \times 10^{-24}$ cm.^{2}. This cross-section can be used to evaluate the capture cross-section of ^{238}U. In this isotope, as Bohr[4] has emphasized, thermal neutrons do not produce fission processes. Thus when equal small quantities of uranium and thorium are subjected to neutron bombardment under identical conditions, ^{239}U and ^{233}Th respectively being produced, it is clear that if on account of their nearly equal half-life the efficiency of the β-rays is assumed to be approximately the same, the β-ray activities due to thermal neutrons (corrected for equal numbers of nuclei) must be proportional to the respective cross-sections :

$$\frac{T^{th}_{\mathrm{U}(239)}}{T^{th}_{\mathrm{Th}(233}} = \frac{\sigma^{th}_{\mathrm{U}(238)} \cdot \frac{1}{238}}{\sigma^{th}_{\mathrm{Th}} \cdot \frac{1}{232}}$$

From earlier measurements carried out in Dahlem, I find for this ratio the value 1/4·15. Using the above value for the cross-section of thorium, the cross-section for uranium 238 is

$$\sigma^{th}_{\mathrm{U}(238)} = 1{\cdot}5 \pm 0{\cdot}2 \times 10^{-24}\ \mathrm{cm.}^2.$$

Anderson and Fermi[5], measuring directly the β-ray intensity of ^{239}U due to a known number of thermal neutrons, found

$$\sigma^{th}_{\mathrm{U}(238)} = 1{\cdot}2 \times 10^{-24}\ \mathrm{cm.}^2.$$

Considering the possibility of fairly large errors in this type of measurement, the agreement is very good.

I wish to express my gratitude to the Academy of Sciences for a grant and in particular to Prof. Siegbahn for the facilities kindly put at my disposal.

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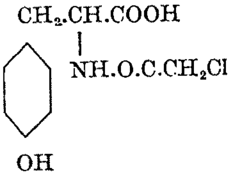
Mechanism of Catalysis by Enzymes

WHILE it is generally agreed that enzymes are true catalysts, the explanation of the mechanism of the reaction is still speculative.

In a previous paper[1] a theory was suggested to explain the catalysis and its reversibility. According to this theory the enzyme, having combined with its substrate, transmits to it a small quantity of energy which activates the substrate by altering the electron distribution in it. The altered electron distribution, by increasing the reactivity of the substrate, increases the reaction velocity. As the reaction proceeds and energy liberated by the formation of new bonds appears the energy borrowed from the enzyme is returned ; the whole mechanism being reversible. While the picture is too static to be strictly accurate and while the mechanism of electron distribution alteration is speculative, it is to be expected from this theory that there would be a relation between the polar constitution of the substrate and the velocity of its hydrolysis in the presence of an enzyme. The electron distribution in a compound depends partly on its polarity.

Abderhalden and Abderhalden[2] have shown that in the presence of acylase, chloracetyl-tyrosine (I) is



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hydrolysed faster than the corresponding bromo compound, which is hydrolysed faster than the corresponding iodo compound. The important difference between these compounds is the polar contribution of the halogen, which is strongest in the chloro compound and weakest in the iodo compound. This case shows clearly the important influence which substrate polarity has on the velocity of enzymatically catalysed reactions. Abderhalden and Abderhalden have also shown that chloracetyl-, bromacetyl- and iodoacetylleucine under the influence of acylase behave similarly to the corresponding tyrosine compounds.

Glick[3], in studies on the specificity of choline esterase, has shown that halogenation of the acid component of acetylcholine increases the velocity of the catalysed reaction. He has also shown that halogenation of both radicals of ethylacetate considerably increases the velocity of the enzymatically catalysed reaction. Commenting on the fact that acetylcholine and chlorethylacetate are split at approximately the same speed, he states that it is peculiar that replacement of the positively polar methylamino group by the negatively polar Cl atom should not influence the reaction velocity. The fact that both these groups are electron attracting groups and exert negative inductive effects on the atoms of the link split explains this apparent anomaly. These examples from Glick's work also show the influence of substrate polarity on the velocity of enzyme action.

That substrate polarity is a factor determining quantitative enzyme specificity is clear from the marked effect which it has on the reaction velocity. Whether substrate polarity can be regarded as a factor determining absolute specificity remains to be seen.

Up to the present there have been many references in the literature to the importance of molecular polarity in biochemistry without any very clear reasons being given. When the influence of polarity on both the uncatalysed reaction (*cf.* Hinshelwood *et al.*[4]) and on the catalysed reaction is borne in mind the significance of this factor becomes clear. For example, changes in the polarity of a drug or other compound can effect its solubility, the rate and magnitude of its action and the rate at which it is destroyed whether enzymatically or otherwise.

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Influence of Cell Wall Composition on the Moisture Relations of Hardwood Timbers

It has already been shown that the compressive strength of hardwood timbers in the green condition is dependent on the degree of lignification as revealed by the behaviour of thin sections with micro-reagents. Thus tropical timbers, with their greater degree of lignification, are on the average stronger than temperate zone timbers of similar density, and the normal wood of temperate zone hardwoods is stronger than tension wood from leaning trees of the same species[1]. The difference in strength between normal and tension wood was found to be less pronounced in air-dry than in green wood[1], and this observation suggested that the influence of the degree of lignification is affected by the moisture content of the wood. In order to examine this possibility a scrutiny has been made of data in the records of this Laboratory or published by other institutions[2,3,4]. The data were taken as a whole, without the exclusion of particular species, and a comparison was made (*a*) between tropical and temperate zone timbers, and (*b*) between normal and tension wood, the influence of density being taken into consideration. In so far as differences in cell wall composition account for the differences between the properties of the timbers under comparison, our observations indicate that the proportional increase in strength which usually accompanies the drying of wood is less in strongly lignified than in weakly lignified material, and consequently differences in strength which are due to differing degrees of lignification tend to be reduced as wood dries. This provides a partial explanation of the fact that the relationship between compressive strength and density is much closer in air-dry than in green wood, particularly in the case of temperate zone timbers.

It was further observed that tropical timbers show a slightly, but significantly, smaller shrinkage both radially and tangentially than temperate zone timbers; they have on the average a lower fibre saturation point (as determined from measurements of shrinkage in drying wood), and reach equilibrium at a lower moisture content when placed in an atmosphere of 90 per cent relative humidity. At 60 per cent relative humidity, however, there is no significant difference between the equilibrium moisture contents of the two groups of timbers.

The data available for the comparison of normal wood with tension wood are very limited in amount, but so far as they go they appear to indicate a behaviour parallel to that of the tropical and temperate zone timbers. The only difference of note is that in two of the three species examined the normal wood showed a slightly *higher* equilibrium moisture content at 90 per cent relative humidity than the tension wood; in the third species no difference was detected. In view of the small number of samples available, however, this point requires further investigation.

It is thus apparent that the equilibrium moisture content, the shrinkage in passing from the green to the air-dry state, and the strength-density ratio in hardwood timbers are all dependent to some extent on the degree of lignification. The influence of the degree of lignification on strength, however, appears itself to be dependent on the moisture content. It is of practical significance that variation of certain properties tends to be reduced as wood dries from the green state to the condition in which it is ordinarily used.

Details of the investigation are contained in Project 18, Progress Report No. 11, copies of which will be obtainable from this Laboratory.

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Pigments of Sponges

The lipochrome nature of the colouring matters of the Porifera or sponges was recognized by Krukenberg[1] who refers to their carotinoid-like and rhodophane-like pigments, the latter being characterized by the possession of a single absorption band. Later spectroscopic study of the pigments of additional species by MacMunn[2] confirmed these observations.

More recently, Karrer and Solmssen[3] have isolated the Crustacean pigment astacene from the sponge *Axinella crista-galli*. They claim that this pigment is also present in *Suberites domuncula*, but this is at variance with an earlier observation of Kuhn, Lederer and Deutsch[4]. No other crystalline carotinoid had so far been isolated from sponges.

We are at present engaged on an investigation of the pigments of the red sponge *Hymeniacidon Sanguineum* (Grant). We have failed to detect astacene but have isolated two carotinoids, echinenone and γ-carotene in crystalline form. We have also obtained spectroscopic evidence of the presence of α-carotene. Echinenone was discovered by Lederer in 1935, who isolated it from the sea-urchin *Echinus esculentus*. Apart from β-carotene it was the first animal carotinoid found to possess vitamin A activity[5].

The demonstration of the presence of the pigment echinenone in sponges provides a chemical link between the otherwise unrelated Porifera and Echinodermata. It would also appear that this is the first occasion on which γ-carotene has been isolated from invertebrates.

We hope to publish a detailed account of this investigation elsewhere.

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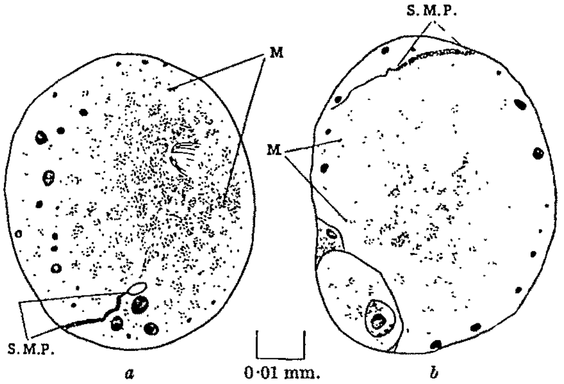
Presence of the Sperm Middle-Piece in the Fertilized Egg of the Mouse (*Mus musculus*)

During an investigation of the cytoplasmic inclusions of the fertilized egg of the mouse, the sperm middle-piece, and in some cases the whole tail, was observed in the ooplasm (*a* and *b*). The middle-piece usually becomes detached from the sperm-head shortly after the entry of the sperm, but may remain attached until the stage of the pronuclei is reached. The middle-piece is, at first, compact and deeply stained, but soon shows a granular structure. These granules are identified as the mitochondria of the sheath of the axial filament (*a*, *S.M.P.*). After the middle-piece is free of the sperm-head the sheath becomes less compact, so that the individual granules can be identified with ease (*b*, *S.M.P.*).

The sperm-mitochondria are slightly larger and are more deeply stained than those of the egg (*M*). At a later stage the mitochondria of the sperm stain in a similar manner to those of the egg; they now form a loose broad band, and are, later, distributed through the ooplasm.

Sperm-mitochondria were not identified during the later phases of the stage of the pronuclei, or during the first cleavage division, or in the two-cell stage.



It is concluded that the sperm-mitochondria become similar in size and staining properties to those of the egg, that they are distributed through the ooplasm and, later, become arranged around the spindle, together with the egg-mitochondria, and are consequently transmitted in approximately equal quantities to the first two blastomeres.

There is also evidence that the Golgi material of the sperm is carried into the egg. It undergoes fragmentation and becomes indistinguishable from the Golgi elements already present in the egg.

The present findings do not support the work of Lams[1], Levi[2], and Van der Stricht[3], who claim that the sperm-tail of certain mammals is segregated into one of the blastomeres of the two-cell stage.

So far as I am aware, distribution of the sperm-mitochondria through the ooplasm before the first cleavage division has not previously been recorded in the eggs of mammals. Held[4] and others, however, have traced the history of the sperm-mitochondria in the cytoplasm of the ova of certain invertebrates.

The present findings are based on the examination of material fixed in Flemming's fluid (without acetic), and of material treated according to the method of Aoyama. It is hoped to publish a detailed account of the history of the cytoplasmic inclusions of the sperm in the cytoplasm of the egg of the mouse.

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Subjective Judgments of 'Firmness' in Elastic and Viscous Materials

In the testing by handling of many industrial products showing both elastic and plastic properties (of which cheese is typical), direct comparisons of 'firmness' are regularly made, although the physical dimensions of the property assessed as 'firmness' are variable. (No satisfactory theory of psychological dimensions has yet been proposed though these certainly differ from physical dimensions.) A study of this phenomenon is being published elsewhere, and in the course of the work it was found that even in the extreme case of truly fluid bitumen cylinders and approximately elastic rubber cylinders of the same size and shape, all the twenty subjects tested were able to give direct simultaneous comparisons for 'firmness'. With one exception, it was only after a considerable number of tests that subjects appreciated the dimensional difficulty, though 'firmness' has in the former material, the dimensions of a viscosity ($ML^{-1} T^{-1}$) and in the latter, those of a compression modulus ($ML^{-1} T^{-2}$).

It was also found that, over a considerable range of modulus and viscosity, a reversal in judgment could be produced by varying the time during which the handling was carried out. This effect was anticipated, since the dimensions of viscosity and compression modulus differ by T^{-1}, but it seemed worth while to carry out a quantitative experiment.

For this purpose, two of our best subjects were chosen. They were given pairs of cylinders, one bitumen cylinder and one rubber (diameter 2·0 cm., height 2·5 cm.), one in each hand, and instructed to squeeze each pair twice in time to a metronome, to change hands, to squeeze twice again, and to give a judgment as to relative 'firmness'. Adequate precautions were taken to eliminate extraneous effects. Times of 0·5 sec. and 4·0 sec. were used, the order of the tests being randomized.

First, a cylinder of truly fluid bitumen (viscosity, 10·7 × 10^6 poises) was compared with a series of rubber cylinders (compression modulus range, 0·78–1·41 × 10^7 dynes/cm.^{2}). In a second experiment, a single rubber cylinder (modulus, 1·53 × 10^7 dynes/cm.^{2}) was compared with a series of bitumen cylinders (viscosity range, 4·6–19·8 × 10^6 poises). The results of these tests are given in the accompanying table.

		Constant viscosity (bitumen)		Constant modulus (rubber)	
		4·0 sec.	0·5 sec.	4·0 sec.	0·5 sec.
1 (male)	Bitumen softer	30	3	25	7
	Rubber softer	1	16	0	19
	Indistinguishable	1	13	7	6
2 (female)	Bitumen softer	31	9	24	15
	Rubber softer	1	23	8	17
	Indistinguishable	0	0	0	0

The effect of varying the pressure of handling was also tested, but found to be insignificant.

A detailed examination of the data summarized in the table indicates that for an eight-fold time difference, the range of viscosity over which a reversal of judgment can be obtained in comparing a series of fluids with a standard elastic sample, shows no marked difference from the range over which the compression modulus of elastic bodies can be varied to give reversals in comparison with a constant fluid sample. Our previous work[1,2] has shown that the compression modulus of elastic materials can be judged subjectively some three times as accurately as can the viscosity of true fluids of the same order of 'firmness'. This depends on the fact that the elastic modulus can be judged statically whereas the viscosity demands a dynamic judgment. When elastic and viscous bodies are simultaneously compared, a dynamic judgment is required throughout.

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[1] NATURE, **143**, 164; **144**, 286 (1939).

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The Nature of Time

IN a recent article, entitled "The Relativity of Time", Prof. Herbert Dingle[1] discussed what constitutes a clock, and he used the discussion to support a thesis which he stated at the outset, namely, that the restricted theory of relativity does not imply a Fitzgerald contraction of time intervals.

Prof. Dingle's conclusions in this regard are untenable, and in order to make clear the errors in his arguments, I shall first state some of the cardinal features of the restricted theory of relativity.

Two inertial systems $O.\ xyzt$ and $O.'\ x'\ y'\ z'\ t'$, with x-axes coinciding, are assumed to be moving relative to each other with a constant velocity, v, say. Then the co-ordinates x, y, z, t and x', y', z', t' are related by the Lorentz equations, and it follows that space intervals and time intervals in either system are reduced by the Fitzgerald contraction factor when observed by an observer at rest in the other system.

The time co-ordinate in each system is given by some cyclic or recurring phenomenon. Fundamentally its nature is that of a dial reading which indicates 'how many'. It is a reading which is observable by each observer in his own system, and is used to designate the temporal order and spacing of the reception and sending of signals.

Consider, then, Dingle's hour-glass type of clock, in which he says either the number of grains N, or the mass of sand MN, M being the mass of a grain, could equally well be regarded as measuring the time. In the second alternative, however, it is not legitimate to measure the total mass in one system in terms of the unit mass of the other, and to use this as time measure, as Dingle has done. Without the Lorentz equations there would be no basis for making such measurements, and therefore the Lorentz equations could not be derived from observations based on time obtained from mass measurements of this kind. Such time measure is alien to relativity and is inconsistent with the Lorentz equations.

Mass could be used to measure time if the man at rest with the clock did the measuring in each case. Thus, if M were the mass of a grain in the first system as measured by an observer in that system, then M is also the mass of a grain in the second system as measured by an observer in the second system. Therefore, if N and N' are the number of grains observed in each, then the masses observed are MN and MN'; and therefore whether the number of grains or the mass of the sand is used as time measure, the clock ratio is the same, namely, N'/N.

Consider now Dingle's second type of ideal clock, namely, "a particle . . . moving freely along an infinite space-measuring scale in a region free from gravitational and other fields of force, the time . . . (being) the reading of the scale at the instantaneous position of the particle". Regarding two such clocks he says, "the time which the stationary clock takes to move over n divisions of its scale must be considered equal to the time which the moving clock takes to move over n divisions of *its* scale. But the latter scale is contracted. . . . Hence the particle of the moving clock moves a shorter distance in the same time; that is, the moving clock must be considered to be running slower than the stationary clock. . . ."

This reasoning is fallacious. For the scale readings *are* the times with which relativity deals, and by the Lorentz equations their rates of change in the two systems are not equal. Also, to say that "the moving clock moves a shorter distance in the same time" is to define the time by the *distance* the moving particle has gone, and then to measure the distance on the *moving* scale by the unit length of the *stationary* scale. This is the same kind of error as was made in measuring the mass of sand in the moving system in terms of unit mass in the stationary system. The time in each system would be identified with the distance travelled by the moving particle if, and only if, the distance in each system were measured in terms of the unit of that system.

The question of the distortion of lengths and time intervals in relativity is one of some perplexity. In both cases it is manifested by light signals, but there is an important difference. In the case of rods, if they were of the same length when relatively at rest, they would appear distorted when in motion, but on coming to rest again they would show equality. In the case of the time intervals of separation, on the other hand, signals are continually received during the separation, and the time interval registered by the moving system is indicated by the accumulation of these signals. The whole rod comes back simultaneously, but the record of the travelling clock is received over the whole interval of separation, and a signal once received is never eradicated.

Dingle says that the time distortion cannot be exhibited experimentally, and with that statement I agree. The special theory of relativity deals with uniform relative motion, and a body under such motion cannot make a 'return trip' from another body. But I have made an extension[2] of the Lorentz transformation to accelerated motion, and this extension makes it possible to consider a return trip. The validity of the extension is confirmed by the consistency of the results from the point of view of observers in the two systems, and also by their agreement with the treatment of time distortion by the general theory of relativity[3]. The conclusion is that while the rod on returning has the same length as the one which remained stationary, the total recorded time of this moving system is less than the total recorded time of the stationary system; that is, the time distortion is real.

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[1] NATURE, 144, 888 (1939).

[2] Campbell, *Phil. Mag.*, (vii), 16, 529 (1933).

[3] Campbell, *Phil. Mag.*, (vii), 15, 48 (1933).

I CANNOT accept Prof. Campbell's criticism, which seems to me to be inconsistent. Apparently he holds that the time of an event is, *by definition*, a dial reading ("Fundamentally its nature is that of a dial reading": "the scale readings *are* the times . . ."). He agrees, however, that "the time distortion cannot be exhibited experimentally". Hence there is no evidence for a change of dial reading (that is, of that which by definition is the time). What, then, is this "time distortion" which he accepts?

Prof. Campbell misrepresents me in his first paragraph. I did not say that a definite contraction of time intervals was not implied: I said that a moving clock would not necessarily exhibit such a contraction. In that lies the main point of my article, which was intended to remove a general notion that measuring time is identical with reading the dial of an unspecified instrument. This notion appears to be even wider-spread and deeper-seated than I imagined, and as I believe it to be erroneous, I venture to give my reasons at some length.

The fundamental unit of measurement in physics is the unit of length: it is the distance between two marks on a bar kept under fixed conditions. The unit of time is the time taken by a specified moving body (one undisturbed by forces, according to Newton's First Law) to cover unit length. The unit of mass is defined in terms of the units of length and time (according to the principle of conservation of mass and momentum in elastic impact). All other units are chosen in terms of these. The unit of length is thus the only one which is chosen without reference to any other unit.

It follows that while the distance between two points can be measured by taking a particular body—the standard bar (which is chosen with some arbitrariness, though not, of course, without regard to convenience and the simplicity of the relations in which measures of length take part)—and laying it along the line joining the points, each other physical quantity can be measured only by first constructing an instrument *according to the principle by which the unit is defined*, and then, if necessary, correcting its readings for any failure of the instrument to incarnate that principle in whatever particular circumstances it is used. In making a measurement, therefore, we must discover not the dial reading but the reading which the dial would record if the principle were faithfully expressed.

The measurement of temperature affords a good example. On the air scale we define the unit interval of temperature as that which produces a given increment of volume in a given mass of air at constant pressure. The reading of the instrument rarely, if ever, corresponds to this, and we correct for expansion of the containing vessel, barometer variations, exposed stem, etc., to obtain the temperature according to the specified principle. There are other scales embodying other principles; for example, the mercury-in-glass scale, platinum resistance scale, etc. The readings of instruments intended to record these scales have similarly to be corrected, and the corrected results differ for the different scales. None of them, however, is the 'temperature' implied in physical theory. That is defined in terms of the 'absolute' or 'work' scale. It is impracticable to make an instrument which even imperfectly embodies the principle of this scale, so we use an air or other thermometer, and adjust its corrected reading to give the 'absolute' temperature.

Now this is very closely parallel to the measurement of time. The air thermometer may be compared with my 'volume-clock': the unit of time is that in which unit volume of sand falls. If the dial does not record this, then its reading must be corrected. The corrected 'mass-clock' and 'number-clock' readings similarly correspond to the corrected mercury-in-glass and platinum resistance thermometer readings, and they may differ from each other and from the volume-clock reading. None of them necessarily shows the 'time' of physical theory, for that is indicated by the 'ideal' clock, which corresponds to the absolute thermometer.

This is commonplace knowledge with regard to temperature, but so far as I know, no one has hitherto pointed it out with regard to time—possibly because all time scales happen to be identical in a single co-ordinate system. Books on relativity usually say simply that a moving clock runs slow by a particular factor, leaving it to be inferred that anything that ticks and moves a pointer round a dial will visually display the Lorentz transformation. It was the purpose of my article to show by examples that this was incorrect, and to discover to what 'clock' the transformation formula applied.

Prof. Campbell maintains that in using a moving mass-clock the observer must move with the clock when measuring the mass but remain stationary when counting the grains. Why this difference? If he consistently moved with the clock he would obviously observe no effect of motion at all, but the action which Prof. Campbell prescribes for him seems a little arbitrary. I suspect that Prof. Campbell has not completely shed the idea of absolute motion; otherwise I cannot account for his allowing N and N' to differ. It is perhaps as well to point out again that, according to relativity, if an observer is initially at rest with respect to two identical instruments, and then one of them moves away from him, the 'change' in the indications of that instrument is exactly the same as if it were undisturbed and the observer, with the other instrument, moved with the same speed. Which is N and which N' in that case?

Finally, Prof. Campbell seems to me to be quite wrong in objecting to, say, my mass-clock measurements on the ground that "Without the Lorentz equations there would be no basis for making such measurements". You do not need the Lorentz equations in order to measure mass. The principles of mass measurement were defined before the Lorentz equations were thought of, and they are not to be changed because the observer decides to move while applying them.

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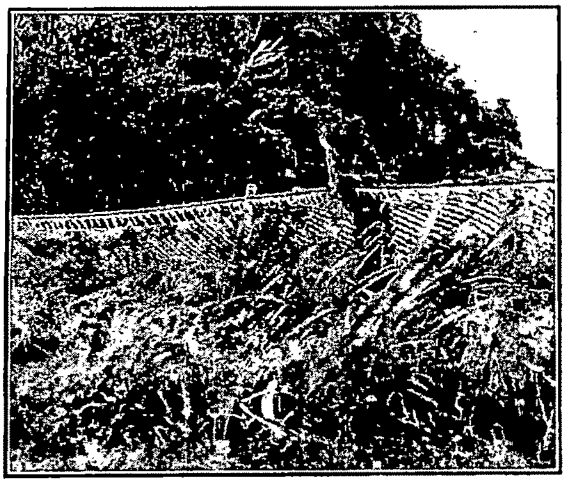
Unusual Ice Formation in Wiltshire

ON January 28 and 29, ice was formed in west Wiltshire under conditions unprecedented in the experience of local inhabitants: a record of the effects may have more than local interest.

January 27 had been a day of relative warmth and of heavy rain after a prolonged spell of frost and sunshine, and water collected over the frozen ground. The early morning of January 28 was also wet, there being a mild drizzle; but water was freezing under foot and the branches of trees crackled. By midday, though rain continued, ice had become a conspicuous feature of the landscape. Blades of grass were embedded in needle-like sheaths, the taller stems in glass-like rods, and dead flower heads had given rise to ice flowers of beauty and delicacy. On hedgerows and trees, on roads, stone walls and wire fences, the same process was at work. Everything, including threads of hair entangled on barbed wire, had become thickly coated; and trees acquired a fantastic appearance suggesting giant candelabra of crystal.



[Photo by O. W. Davies

By January 29 the ice had thickened. Grass blades were no longer encased in needles but in thick fingers of ice, and fields became most uncomfortable to walk over. Where grass stood high amid erect heads of dock, plantain, napweed, yarrow, etc., they had become a growth of brittle ice-bound stems. The weight of ice on trees and telegraph wires was now overwhelming and large boughs crashed to the ground.

Accurate measurements of the ice were not made. It was formed on the exposed and on the upper sides of supporting surfaces. In section, the fingers of ice were roughly elliptical, the original support occupying a position near the periphery in the longer axis. Around telegraph wires the ice was, however, circular (*circa* ¾ in. in diameter) which suggests the wires had undergone torsion. Icicles hung from some of the trees and from the eaves of buildings, but were not a conspicuous feature of the landscape.

Since the above was written a similar account of the same storm at Petersfield has been published by Cave[1]. Comparison of the two suggests that ice formation in Wiltshire started some twelve hours later but followed the same course. Storms of the kind are evidently rare though on record[2,3,4] and information is scanty on their causative factors, on the growth of the ice, and on its effects upon living vegetation. The report[5] that on March 5 New York experienced the worst ice-storm for 25 years is also of interest.

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[1] Cave, C. J. P., An Ice Storm, *The Times*, February 13, 1940.

[2] Piebourg, P., Sur les effets produits, à Fontainbleau, par le verglas des 22, 23 et 24 janvier 1879, *Compt. Rend. Acad. Sci.*, 1, 245 (1879).

[3] Godefroy, L., Le verglas du mois de janvier 1879, *Compt. Rend. Acad. Sci.*, 1, 244 (1879).

[4] Pattinson, J., and Dines, J. S., Glazed Frost, January 1940, *Met. Mag.*, 75, No. 889, p. 12.

[5] *The Times*, March 6, 1940.

Witwatersrand Local Tremors

IN an article on "The Earthquake in Turkey"[1] Mr. E. Tillotson refers to the idea that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world. In this relation he points out that on the same day as that on which the earthquake occurred in Turkey, December 27, 1939, earthquakes occurred in San Salvador, Los Angeles, Tangier and "Between December 27 and 28, twenty-five earthquakes and earth tremors . . . shook the gold mining district of the Rand near Johannesburg in South Africa".

The reference to the Witwatersrand may be misleading without further knowledge of the conditions prevailing there. Earthquakes do not occur on the Witwatersrand, but local tremors are of frequent occurrence. These tremors were unknown before 1908; they began then to attract attention and their numbers increased very rapidly for some years and then more slowly. The frequency of their occurrence has kept pace closely with the increase of mining activity. A statistical study of the Witwatersrand local tremors covering a period of twenty-seven years has recently been undertaken by Dr. P. G. Gane of the Bernard Price Institute of Geophysical Research, Johannesburg[2].

Dr. Gane accepts the idea that the primary cause of these tremors is the local instability due to mining operations and has attempted to find 'trigger-forces' which might affect their actual occurrence. He concludes that blasting in the mines is likely to be by far the most effective trigger.

During the year 1939, 2927 local tremors were recorded by the seismograph at the Union Observatory, Johannesburg. Of this number, 286 were strong enough to be felt. There appears to be a tendency for the tremors to occur in groups. Such a group was experienced on December 27–28, but the occurrence of a large number of tremors in one day is not a particularly outstanding event, and should not be considered as having any bearing on the question of sympathetic earthquakes without further investigation.

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[1] NATURE, 145, 13 (January 6, 1940).

[2] *J. Chem. Metall. Mining Soc. S. Africa*, October 1939.

Mutarotation of Gelatin

SUBSTANCES which exhibit optical activity in solution do so as a result of molecular dissymmetry, the most common cause of which is the presence of an asymmetric atom in the molecule. In the crystalline condition, optical activity may be exhibited by substances which do not contain dissymmetric molecules. In this case, the optical activity is due to a dissymmetric arrangement of the units which make up the crystal and disappears when the crystal is dissolved, because the structural dissymmetry is thus destroyed. Certain substances with dissymmetric molecules show a combination of these two effects, structural dissymmetry being superposed on the molecular dissymmetry in the crystalline condition.

These well-known facts have a bearing on the mutarotation of gelatin, that is, the change in optical rotatory power which is associated with the sol $\rightleftharpoons$ gel transformation. The optical activity of the sol is derived from the asymmetric carbon atoms of the protein molecules. In the gel, optical activity due to a dissymmetric arrangement of the protein molecules is superposed. The mutarotation therefore adds to the evidence that the protein molecules form an ordered, rather than a random, structure in the gel.

These views may have been implied by previous authors but they do not appear to have been explicitly stated.

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Points from Foregoing Letters

FROM combined X-ray and chemical evidence, W. T. Astbury and Florence O. Bell put forward a model for the molecular structure of the fibres of the collagen group. The average length per amino-acid residue in the direction of the fibre axis is about 2·85 A., and the intramolecular pattern requires no fewer than 288 residues in a row. Owing to the high content of proline and hydroxyproline the polypeptide chains are partly in a *cis*-configuration, as opposed to the rather longer *trans*-configuration of the β-proteins.

Experiments are described by L. Meitner which give the capture cross-sections for thermal neutrons in thorium and lead. Using the thorium capture cross-section and the ratio of β-ray activities of ^{239}U and ^{233}Th (under identical experimental conditions) due to thermal neutrons, the capture cross-section for thermal neutrons in ^{238}U is obtained as well.

A new conception concerning the effect of substrate polarity on the velocity of enzymatic catalysis is pointed out by D. B. Taylor. Substrate polarity is suggested as a factor influencing enzyme specificity. The significance of substrate polarity is discussed.

S. H. Clarke and C. B. Pettifor find that the equilibrium moisture content, the shrinkage during drying, and the strength-density ratio in hardwood timbers are apparently dependent on the degree of lignification as revealed by histological reagents; moreover, the influence of the degree of lignification on strength is itself dependent on the moisture content of the wood.

Two carotinoid pigments, echinenone and γ-carotene, have been isolated from the red sponge *Hymeniacidon Sanguineum* by P. J. Drumm and W. F. O'Connor. The Crustacean pigment astacene, hitherto the only carotinoid isolated from a member of the Porifera, was not present.

R. A. R. Gresson finds that during fertilization the sperm middle-piece, and in some cases at least, the entire tail, is carried into the egg of the mouse. The mitochondria of the sheath of the axial filament become distributed through the ooplasm, and are presumably transmitted, in approximately equal numbers, to the first two blastomeres. There is evidence that the Golgi material of the sperm is also introduced into the egg; it undergoes fragmentation and becomes distributed through the cytoplasm.

G. W. Scott Blair and Miss F. M. V. Coppen find that direct subjective comparisons of 'firmness' can be made between elastic and fluid materials where the dimensions of 'firmness' vary by T^{-1}, but that a reversal of judgment is obtained over a wide range by varying the time of testing. The range is about the same whether the viscosity or the compression modulus is varied.

RESEARCH ITEMS

Ancient Gold-working Site in Rhodesia

A midden site on the Macardon Claims, West Nicolson, Gwanda District, Southern Rhodesia, discovered by Mrs. Winifred Macdonald and examined by her, produced material of no little interest which has been described by Neville Jones (*Trans. Rhodesia Sci. Assoc.*, 37; 1939). The size and thickness of the midden deposit suggest an occupation by one or two families for not more than fifty years. A flattish granite rock which outcrops on the surface is almost entirely covered by dolly-holes and was evidently used for the purpose of crushing the auriferous quartz mined in the vicinity. The crushing was done by means of pestles of diorite some of which were found still standing in the holes as the original inhabitants had left them. Most of the holes contained fragments of quartz broken to a size convenient for dollying. A little fine gold was obtained from the holes. Objects found included a portable crushing mortar, hammers, gold in the form of beads, cylindrical and tubular, foil, tacks, links, etc., twisted copper wire, copper chain fragments and links, copper beads and needle, objects of iron, including battle axes, imported celadon ware, beads and bored sea-shells (Polinices, Cypræa and Oliva), locally made ornaments of soapstone, beads of ivory, ostrich shell, achatina shell, amulets, pottery and a portion of a tuyère for ore reduction and slag. The gold beads are significant for methods of manufacture. From the evidence of the pottery, which is of the Sotho and Shona traditions, the celadon, the beads and the association of gold objects, it is probable that the Macardon site is to be dated at about the close of the fifteenth century.

The 'Ultra-Perceptive' Faculty

The existence of an 'ultra-perceptive' faculty, that is, the extension of perception beyond the normal and intellectual range, is not proved, but the scientific study of such perception has during the last few years received a fresh impetus. A paper by Dr. J. Hettinger, prepared for the Dundee meeting of the British Association, gives an account of an attempt to test statistically the probability of such a faculty. More than 150 subjects took part in the experiments which were carried out with the assistance of two professional 'sensitives'. Articles obtained from the subjects were placed in separate sealed envelopes and taken by the experimenter to the residence of the sensitives; one of the sensitives handled the envelopes while the other merely concentrated on the envelope laid on the table. The 'sensitive' then commented on the subject owning the particular article; for example, concentrating on one article, the sensitive said, "Pile of shillings, as if saved for some purpose". The subject with reference to this said, "I was counting the takings in a shop at the time, and had silver in piles." As a control, for each item given with regard to a particular subject by the sensitive an equal number of fictitious items was presented for acceptance or rejection. The results were treated to a detailed statistical analysis, and it was found that the deviation from chance expectation was more than fourteen times the probable error, indicating the probable existence of an ultra-perceptive faculty.

Age of Wild Birds of Prey

In a short paper E. Lowell Sumner, jun., gives the ages attained by representatives of a few species of raptorial birds which had been ringed by him during the past fifteen years (*Condor*, 42, 39; Jan. 1940). The greatest age was attained by a screech-owl, *Otus asio quercinus*, which was shot thirteen years after ringing, and the average age of five returns of this species was 5 years. A barn-owl, *Tyto alba pratincola*, lived for 10 years 4 months, and the average of eleven returns was 3 years 2 months; two horned owls, *Bubo virginianus pacificus*, almost equal in age, averaged 2 years 6 months. The diurnal birds of prey seem to have rather shorter spans. Of four recovered red-tail hawks, *Buteo borealis calurus*, the oldest had survived for 1 year 5 months, and the average was only 7¾ months. One Canadian golden eagle was captured at least 3 years 10 months old, and one sparrow-hawk, *Falco sparverius*, at 2 years 7 months. The numbers ringed and recovered in this experiment are too small to give a reliable indication of either average or maximum age, but the distances at which the birds were recovered suggest the relative tendency to wander. The four red-tails were captured at an average distance from the ringing place of 69 miles, the single golden eagle and sparrow-hawk respectively at 23 and 10 miles, the eleven barn-owls averaged 21 miles, as against one mile for the five screech-owls, whereas the single long-eared owl recaptured had travelled 49 miles.

Toxicity of Selenium-containing Plants to Pests

Among papers read before the annual meeting of the American Association for the Advancement of Science, which took place at Columbus (Ohio) at the end of December last are two on the above subject. V. H. Morris, C. R. Neiswander and J. D. Sayre discussed a method of rendering corn plants resistant to red spider attacks by growing them in nutrient solution to which was added each week 1 p.p.m. of sodium selenate. When the rate of selenium application was increased to 2 or 3 p.p.m., no red spiders were found to survive. Under such conditions the growth and normal nutrition of the plants was unaffected. Similar results have been obtained in additional tests with a number of other species of plants. In the second communication Messrs. Neiswander and Morris described results of experiments indicating that an accumulation of 90–100 parts per million of selenium in the tissues of certain plants was sufficient to prevent infestation by the common spider, *Tetranychus telarius*, and that a lesser amount controlled the chrysanthemum aphid *Macrosiphoniella sanborni*. The investigation suggests a possible method for controlling pests of ornamental plants.

Viruses and their Insect Vectors

The complex relations which exist between a plant virus and the insect which transmits it have been studied by M. A. Watson and F. M. Roberts (*Proc. Roy. Soc. Lond.*, B, 127, 543–576; 1939). They used three viruses, namely, potato virus '*Y*', cucumber virus 1 and Hyoscyamus virus 3, which cannot be transmitted mechanically and are non-persistent in the insects which transfer them. Three species of aphid were used as vectors: *Myzus persicæ*, *M. circumflexus* and *Macrosiphum gei*; their efficiency in transmitting the viruses increased with increasing time of fasting before feeding upon infected plants, and decreased as the time of feeding upon the diseased hosts increased. It would therefore appear that the viruses are inactivated by some substance produced by the aphids when feeding. *Myzus persicæ* was the most successful vector, but the efficiency of each aphid varied according to the concentration and localization of virus in the plant, and to the inhibitive capacity of the insect for the virus.

Erosion Surfaces in the Allegheny Plateau

AT the annual meeting of the American Association for the Advancement of Science, during December last, J. L. Rich presented an illuminating paper on the identification and interpretation of erosion surfaces. Aerial photographs of selected parts of the Allegheny plateau were used to illustrate the thesis that projected profiles or visual inspection of skyline elevations cannot be relied upon for the determination of the altitude of an erosion surface unless the region has not passed beyond the mature stage of the cycle of erosion. For all post-mature stages an indeterminate amount of elevation must have been lost by the inter-valley divides. Physiographic evidence proves an enormous difference in the rate of erosion between certain shale horizons in the Pennsylvanian and the massive Pottsville conglomeratic sandstone at its base. The difference is such that two or more cycles can be brought to old age stage on the shales, while the first cycle has scarcely passed infancy on the sandstone. In view of these complications, due to rock resistance and its bearing on the stage reached in the erosion cycle, it is clear that a re-examination of the physiography of the plateau is called for.

Decomposition of Azomethane

THE decomposition of azomethane yields different products depending on the procedure employed. Emmett and Harkness (*J. Amer. Chem. Soc.*, 54, 538; 1932) found that catalytic decomposition using an iron (synthetic ammonia) catalyst gave methylamine as an intermediate product and ammonia, hydrogen and carbon as principal end products, while Taylor and Jahn (*J. Chem. Phys.*, 7, 470; 1939) found that pyrolysis and photolysis gave initially methyl radicals which added on to azomethane molecules forming tetramethylhydrazine, which afterwards decomposed. Recently, Henkin and H. A. Taylor have reported data (*ibid.*, 8, 1; 1940) on the decomposition of azomethane by atomic hydrogen at 27°, 110°, and 195°. At 27°, gaseous products were absent. A liquid product, obtained in a liquid nitrogen trap, contained a small fraction volatile at −78°, which was probably unchanged azomethane. The non-volatile liquid component, which was, therefore, presumably the sole product of the reaction, was colourless, basic, and a good reducing reagent. It gave the azo-cuprous chloride complex characteristic of a secondary hydrazine, and microanalysis of the picrate and oxalate showed it to be *s*-dimethylhydrazine. The absence of hydrocarbons indicates the non-rupture of the azomethane molecule. At 110°, methane and ethane were present (10 : 1). A considerable proportion of the liquid product was volatile at −78°, and combustion tests on the gas indicated methylamine. The residual liquid was again dimethylhydrazine. The liquid product from the 195° decomposition contained a larger amount of methylamine; the ethane yield was almost zero, and the amount of methane was only 20 per cent of that at 110°. Analysis of the fraction non-volatile at −78° indicated a compound with a nitrogen content lower than dimethylhydrazine. This is explained by assuming that methyl radicals join to azomethane molecules, with the ultimate production of tetramethylhydrazine and trimethylhydrazine. The possible mechanisms involved at the different temperatures are discussed.

Diffraction of Protons by Vapours

DETERMINATION of molecular structure by electron diffraction is now a well-established method. Provided that a suitable source and technique could be developed, the diffraction of protons by vapours is an extension of this method of great potentiality, since the intensity of scattering of protons by an atom should be about 2,000 times greater than the scattering of electrons. Light molecules could then be investigated. A first attempt in this direction is reported by H. J. Yearian (*J. Chem. Phys.*, 8, 24; 1940), who describes an apparatus and preliminary results on carbon tetrachloride which agree satisfactorily with electron diffraction data. An arc of 0·5–2·0 amp. is struck in hydrogen in a stainless steel ion source and the ions are accelerated to 1·5–2·0 kv. The beam (approximate composition, 20 per cent H_1^+, 50 per cent H_2^+, 20 per cent H_3^+, 10 per cent heavy ions) is resolved into its ionic constituents by a magnetic field and the selected beam, after suitable focusing, falls on a stream of vapour at 10^{-5} mm. pressure. The scattering is recorded photographically. Many difficulties of technique were encountered, principally space charge effects near the ion source, neutralization of the beam by molecules of the vapour, loss of sensitivity of the photographic film due to outgassing. Precautions taken to minimize these and other difficulties are discussed. The experience gained in these preliminary experiments has indicated certain desirable modifications of technique, which are outlined. This investigation may well be the precursor of an important new method of elucidating the structure of molecules.

Age of a Meteorite

A SHOWER of fragments of a stony meteorite which fell in Putulsk (Poland) in 1868 were supposed, on account of the reported high heliocentric velocity, to be extra-solar material, although this result is not confirmed by recent recalculation (C. C. Wylie, *Science*, 9, 264; 1939). The protactinium contents of this meteorite and of a granite low in radioactive material as representative of terrestrial material of similar composition have been determined by W. C. Schumb, R. D. Evans and J. L. Hastings (*J. Amer. Chem. Soc.*, 61, 3451; 1939) and the protactinium/radium weight ratios found. From the results the conclusion is reached that within the limits of error the age of the uranium atoms in this specimen of the Putulsk meteorite is the same as for terrestrial uranium. The protactinium was determined by co-precipitation with zirconium phosphate, followed by purification of the ignited pyrophosphate, the alpha-ray activity being measured on a recording alpha-ray counter. The method will determine as little as 10^{-13} gm. of palladium per gm. of siliceous material.

SEA FISHERIES OF EUROPE

ONE of the most valuable as well as the most generally interesting of the various publications of the Conseil Pérmanent International pour l'Éxploration de la Mer is its *Statistical Bulletin*, in which are tabulated extensive and detailed statistics relating to the sea fisheries of the maritime countries of northern and western Europe. Even in normal times, such ample and diverse data require much time and labour to assemble and work up. But in the recent years of economic instability and wildly fluctuating currency values the difficulties of such work have very greatly increased. Nevertheless, by the diligence and resourcefulness of the editor and his staff, they have all been heroically met and successfully overcome, and volume 27, presenting the data for the year 1937, has recently been published*. In order to facilitate interpretation of the mass of detailed tables, a very comprehensive and extremely lucid summary of the main conclusions to be drawn from them is given—as in previous years.

The total quantity of fish landed in 1937 from all the sea fisheries of northern and western Europe (omitting Russia but including Iceland and Faroe) was more by about 4 per cent than in the preceding year; but for the nine principal countries the gain over the preceding year was no more than 2 per cent. For these nine countries the total landings were 32 per cent above the total landings in 1913, the last year prior to the War of 1914–18, which has long been used as a standard of comparison. (Table 1.)

From the British point of view the most comforting information contained in the *Bulletin* is that England, after many unsatisfactory years, at last showed an appreciable increase in landings with a rise of 7 per cent in the total catch in 1937 over 1936. But by far the largest increase was shown by Iceland with 27 per cent increase, followed by Holland with 15 per cent and Germany with 11 per cent. Both the German and English increases are shown to be due in large measure to the opening up of the Arctic trawl fishery at Bear Island and Spitsbergen.

TABLE 1.

TOTAL QUANTITY OF FISH LANDED (IN '000,000 KILOS OR 1,000 TONS) AND PERCENTAGE-RATIO TO 1913.

	Total quantity				Ratio to 1913			
	1913	1935	1936	1937	1913	1935	1936	1937
England	820·5	729·9	804·0	865·4	100	89	98	105
Norway	731·5	1036·6	1146·9	1035·2	100	141	157	142
Scotland	397·6	279·7	257·3	238·8	100	70	65	60
France	193·2	264·0	275·3	313·4	100	137	143	162
Germany	181·4	468·9	569·0	632·6	100	259	314	349
Holland	147·1	119·0	160·4	185·6	100	81	109	126
Sweden	72·8	104·8	110·1	119·1	100	143	151	164
Denmark	64·4	83·5	83·6	85·5	100	130	130	133
Ireland[1]	34·4	11·4	11·5	12·8	100	33	33	37
9 countries	2642·9	3097·8	3418·1	3488·4	100	117	129	132
Iceland	92·2	266·1	261·0	332·7	100	288	283	361
Faroe Island	22·4	49·5	44·0	57·7	100	221	196	258
Finland	15·7	23·5	28·2	28·6	100	150	180	182
Belgium	13·1	36·3	36·8	35·2	100	277	281	269
13 countries	2786·3	3473·2	3788·1	3942·6	100	125	136	141

[1] Eire and Northern Ireland.

TABLE 2.

ESTIMATED VALUE PER 100 KILOS (IN PRE-WAR SHILLINGS[1]) AND PERCENTAGE-RATIO TO 1913.

	Value				Ratio to 1913			
	1913	1935	1936	1937	1913	1935	1936	1937
England	24·4	30·9	26·3	21·3	100	127	108	87
Norway	8·3	6·3	5·7	6·1	100	76	69	73
Scotland	19·7	26·0	26·0	22·2	100	132	132	113
France	50·4	49·7	49·4	38·2	100	99	98	76
Germany	25·0	17·5	17·4	15·0	100	70	70	60
Holland	27·1	21·0	18·2	15·4	100	78	67	57
Sweden	23·9	24·6	21·6	17·7	100	103	90	74
Denmark	29·6	36·8	34·4	30·3	100	124	116	102
Ireland[2]	17·2	27·2	25·2	20·3	100	158	147	118
9 countries	21·3	21·4	19·1	17·0	100	100	90	80
Iceland	11·5	4·5[3]	3·9[3]	3·8[3]	100	39[3]	34[3]	33[3]
Faroe Island	12·1	10·4	8·9	7·6	100	87	74	63
Finland	28·7	28·9	25·6	20·6	100	101	89	72
Belgium	36·6	36·9	38·6	35·8	100	101	105	98
13 countries	21·1	20·1	18·2	16·0	100	95	86	76

[1] Estimate based on wholesale price-index from year to year in accordance with the principles adopted by Nellemose in *Rapp. et Proc.-Verb.*, **98**. "A Review of Fishery Statistics in Relation to Wholesale-Index".

[2] Eire and Northern Ireland.

[3] Reduction too great; cost-of-living index used in lieu of wholesale index.

Concerning Scotland, however, the all too dismal tale, continued over many years, has once again to be told. For more than ten years previous to 1937 the Scottish landings had been diminishing and in that year they had fallen to less than two thirds (60 per cent) of those of 1913, and were 7 per cent less than those of 1936. Only two other countries showed diminished landings in 1937 as compared with 1936—Norway by a little and Belgium by about 5 per cent. Nevertheless, both these countries landed much more fish than in 1913—the former 1½ times and the latter 2½ times the 1913 total.

The most outstanding changes in the share of the total catch taken by each of the principal countries were shown by the British and German landings. Once more comparing 1913 with 1937, it is found that the combined shares of England, Scotland and Ireland had fallen from 45 per cent to 28·5 per cent, while Germany's share had risen from 6·5 per cent to 16·2 per cent of the whole.

In spite of formidable difficulties in ascertaining, computing, and comparing the values of the catches in the different countries, and the still greater difficulty of finding a basis of comparison with the values of former years, the attempt has been made and careful estimates based on price indexes, are presented. This done and the price of fish adjusted to the general price index, the surprising fact emerges that the value of fish per kilo, at least until 1936, appears to have changed very little since before the War of 1914–18; that is, whatever the apparent changes in market prices may have been, the *relative* price of fish remained much as before. Germany and Holland, however, were an exception, for in those countries the adjusted fish prices were much lower in 1936 than in immediately preceding years and notably lower than in 1913, probably because in these two countries the markets were better supplied than formerly and fish had become a more plentiful and cheaper food.

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* *Bulletin Statistique des Pêches Maritimes des Pays du Nord et de l'Ouest de l'Europe.* Rédégé par Sir D'Arcy Wentworth Thompson. Vol. 27 (pour l'Année, 1937). København: Andr. Fred. Høst and Fils). Kr. 3.00.

A still more curious and surprising thing is that the adjusted prices of 1937, as compared with those of 1913, were lower in all countries except Scotland, Ireland, and Denmark. In the first two countries fish prices appeared to remain considerably above the 1913 level; and in Denmark, although decreased by about 20 per cent in two years, they still remained above the pre-War level. In all other countries, and most notably in Germany and Holland, fish appears to have been considerably cheaper in 1937 than in 1913. In Table 2, where the prices in recent years are given and also their percentage ratio of the 1913 values, the all but universal reduction in fish prices between 1935 and 1937 is very conspicuous. No explanation of this very remarkable fact is attempted.

From these and many other equally interesting general considerations, the *Bulletin* proceeds to give more specialized information concerning such matters as the landings of different fishes, and groups of fishes, from the numerous fishing grounds; the shares of the various participating countries in these landings; and even the seasonal fluctuations in the mean monthly landings of certain fishes of special importance, for example, plaice and sole, from the North Sea and elsewhere.

For all those with any interest in fish or fisheries, whether from the scientific or commercial point of view, the *Statistical Bulletin* is a mine of useful information most attractively presented. Not least among the many harmful results of the present War will be yet another interruption in the continuity of much of the data upon which the *Bulletin* is based.

AERIAL, GEOLOGICAL AND GEOPHYSICAL SURVEY OF NORTHERN AUSTRALIA

BY DR. L. DUDLEY STAMP

FOR roughly a century the development of tropical Australia proceeded in an atmosphere of unqualified optimism. It was almost universally believed that only capital and enterprise were needed to render richly productive of minerals and agricultural wealth the vast untenanted northern half of the continent. Agricultural successes on the well-watered coast of Queensland were used to discount a dismal succession of failures elsewhere, and a few highly successful mining enterprises caused a willing public to forget many failures. Within the last fifteen years a professor in an Australian university who dared suggest that tropical Australia was far from being an El Dorado and in any event could only be developed by permitting coloured immigrants was so pilloried by the Press that he sought refuge in resignation. But the negligible return for a huge expenditure of public money at last rendered inevitable the conclusion that all was not well, and the long reign of optimism was succeeded by a period of extreme pessimism.

In the last few years has come the realization that the whole problem of tropical Australia needs to be examined scientifically and without prejudice, using all the weapons at the command of the modern investigator. In that spirit the three Governments concerned—the Governments of the Commonwealth, Queensland and Western Australia—agreed to inaugurate a survey with the object of seeking new mineral resources in the parts of the continent lying north of 22° S. £150,000 was provided—half by the Commonwealth Government, a quarter each by the other two—and it was intended originally to devote three years to the work. It was the first time in the history of Australia that three Governments had pooled their resources for such an investigation. On September 19, 1934, a party of four (Mr. P. B. Nye, executive officer of the Survey, Mr. L. C. Ball, Queensland, Mr. F. G. Forman, Western Australia, and Dr. W. G. Woolnough, Commonwealth geological adviser) set out on a preliminary reconnaissance flight of 12,000 miles to determine areas suitable for investigation. It was agreed that out of more than a million square miles approximately some 10,000 square miles could reasonably be covered in three years, the survey being confined to metallic minerals, particularly gold. Survey work actually began in May 1935 and falls into three parts. Aerial photography was carried out by the Royal Australian Air Force; ground surveys by three parties (in Queensland, Northern Territory and Western Australia respectively); geophysical surveys in selected areas were at first carried out under contract by the Electrical Prospecting Company of Sweden (Mr. Sepp Horvath) and later by the Survey staff itself.

The Survey has issued comprehensive progress reports every six months, beginning with a combined one for the whole period ended December 31, 1935. Those for the periods ended December 1935, 1936 and 1937 are particularly valuable as general summaries, and in the last it was pointed out that the work was far from complete and that it was to be continued during 1938. The detailed results are contained in the individual reports, of which there are thirty-nine for Western Australia, thirty-seven for the Northern Territory and thirty-five for Queensland, though all are not yet published. These 111 reports follow a uniform plan: all are issued by the Government Printer, Canberra, they are in foolscap size with appropriate maps, and set out the facts, favourable or unfavourable, on which private enterprise may assess the possibilities. Many are short—a page or two of text—and naturally most deal with ore fields previously known.

A particularly interesting report is Queensland No. 9—on the Croydon-Golden Gate area which was formerly one of the chief gold producers of Queensland and yielded £3,000,000 worth of gold before being closed down some years ago. It was hoped that geophysical methods would lead to the discovery of new reefs beneath the cover of Cretaceous sandstones, laterite and alluvium. The methods used—electromagnetic, self-potential, magnetic—are described, and here the electromagnetic was found most successful and disclosed numerous good conductors considered to arise from reef-channels at depths corresponding approximately to water-level. The Survey was empowered to carry out shallow tests but not drilling, and so further work is left to private enterprise.

Report No. 17 of the Northern Territory on the Fletcher's Gully Area, Daly River, may be selected as illustrating a type of history all too common. Traces of gold were discovered in 1905 in almost uninhabited country 100 miles south of Darwin. A 'gold rush' of about thirty miners followed, but in three months only two remained—working stream tin—and the claims were soon abandoned. In 1909 a group of Chinese got 183 ounces of gold by steady work, but in 1910 the area was declared a 'goldfield' and the Chinese had to leave. The field was again abandoned after a few months. In 1912 the Chinese returned. In 1918 a new serious start was made by erecting a battery, but it apparently was never used. In 1926–29 there was a little spasmodic working by a few old Chinese. Now the Survey discloses small sub-horizontal reefs, some possibly with payable values, but does not encourage further work.

In some reports comes the thrill of new discoveries. Queensland No. 12 deals with an area in Cape York Peninsula, proclaimed a goldfield in October 1936 and surveyed in the following months. Even there the old type of prospector had penetrated so long ago as 1878 and may have assessed the true value of a mineral field, which now promises to be more important for its iron ore.

It is impossible, in the course of a brief review, to do more than indicate the existence of these valuable reports and to congratulate all concerned on the solid work they have carried out—especially Sir Herbert Gepp, the director, Messrs. Ball, Forman and Pye, his executive committee, and Messrs. C. S. Honman, P. S. Hossfeld, K. J. Finucane, R. F. Thyer, E. L. Blazey and their assistants, of the field staff.

BROADCASTING OVER WIRES

THE idea of conveying speech and music programmes over a wire network is by no means new in Great Britain, for so early as 1895, the Electrophone Company provided a service to telephone subscribers by special connexion to theatres, music halls and churches. Until a few years ago, however, no serious development had taken place owing to the indifferent quality of the service, the absence of suitable loud speakers and amplifying equipment, and the lack of public demand resulting from the relatively high cost involved. The introduction and success of radio broadcasting, accompanied by revolutionary developments in technique and equipment, have caused renewed attention to be given to the possibilities of diffusing programmes over wire networks. For some years past a number of relay companies have been re-distributing the ordinary broadcast programmes over special wire network systems to subscribers who prefer this mode of reception to that involving the use of a normal receiver.

On March 30, 1939, the Postmaster-General announced that the Post Office was contemplating the introduction of a system of distributing broadcasting programmes over the line telephone network, as a service additional to that of the existing relay companies (see NATURE, April 8, 1939, p. 592). In a paper read before the Wireless Section of the Institution of Electrical Engineers on March 7, Dr. T. Walmsley gave an account of the technical progress made in this subject up to the outbreak of the War, by the Wire Broadcasting Branch of the General Post Office. After referring to the fact that the wire broadcasting system is likely to be relatively free from the various types of interference to which radio broadcasting is subject, the paper presented a detailed consideration of both the principles and the technique involved in distributing over wires at either audio or radio frequencies.

While the audio frequency system of distribution could make use of existing telephone lines, considerable interference with other telephone circuits would result if the electrical energy were transmitted over the lines at a sufficient level to operate loud-speakers direct. Thus either the energy level must be reduced and an amplifier used on the listener's premises, or a special wire network must be employed. The latter system is the more satisfactory and has been more widely used up to date. Two arrangements of the scheme are possible; the first provides a separate pair of wires for each programme from the distribution station to a selector switch at the listener's premises; while the second provides several programmes over one pair of wires to the listener, who, by means of a special switch, is enabled by remote control to select one of several programmes available at the distribution station. Which of the two is the more suitable depends largely upon local conditions, the geographical distribution of the subscribers, and the relative costs of the switching systems and the installation of the necessary lines. The remote switching system has many interesting technical features, which are fully described in the paper.

The chief attraction of the distribution systems involving carrier or radio frequencies lies in the fact that the existing electricity supply or telephone networks may be utilized, with a consequent saving in line plant costs. The fact that the electricity supply networks in Great Britain are connected to a larger number of premises than the telephone network constitutes the chief advantage of their utilization for distribution of programmes at carrier frequencies. This advantage has, however, limitations set by technical problems such as insulation, so more attention has been given to the use of telephone lines for this purpose. By choosing the carrier frequencies to be within the normal radio broadcasting band, the subscriber can conveniently use a normal commercial broadcasting receiver, the various programmes available over the telephone system being selected by tuning the receiver to certain assigned radio frequencies. The switch at the listener's premises is naturally provided with a change-over position in which the receiver is connected to a suitable aerial for reception of other broadcast programmes in the usual manner.

Dr. Walmsley's paper described the technical development of the equipment which has resulted in this method being placed on a satisfactory and practical basis. The reading of the paper was accompanied by a demonstration of the reception of both normal broadcasting and of special programmes over the standard Post Office telephone lines, using both the audio and radio frequency methods described. In the latter case, the reception is unimpaired by the use of the subscriber's telephone for a call and conversation in the usual manner. R. L. S-R.

RITUAL IN TIKOPIA OF THE SOLOMONS*

IN the first volume of his account of the ritual cycle known as "The Work of the Gods" in Tikopia, an isolated community in the British Solomon Islands Protectorate, Prof. Raymond Firth has confined himself mainly to giving an ethnographical account, reserving for later publication the major part of theoretical interpretation. In his introductory remarks, however, after pointing out that this, the most spectacular of his discoveries, had been mentioned only by the Rev. H. J. Durrad and Dr. H. R. Rivers without any hint that they were anything more than isolated performances, he goes on to indicate its basic significance for the understanding of Tikopia, while its analogies with rites in Hawaii and Tonga suggest interpretations of these latter, which cannot be inferred from the existing fragmentary and obscure accounts.

The rites fall into several main divisions: a symbolic set to initiate the cycle; a resacralization of canoes; a reconsecration of temples; a series of harvest and planting rites for the rain; a sacred dance festival; several memorial rites and the rites of vanished temples; and in the trade wind season, the ritual manufacture of turmeric. The rites are one of the most elaborate expressions of the system of rank and of the religious beliefs of the people; it has important economic aspects, is related to the institution of marriage, sets the formal seal on fundamental forms of recreation, and provides sanctions for many of the most basic values.

The concrete title "The Work of the Gods" embodies two concepts: first that of a religious sanction, and secondly that of the ritual as a series of obligations involving the expenditure of goods and time. The religious sanction lies in the fact that the ritual cycle is believed to have been instituted primarily by one deity, the principal god of Kafika, who at the same time is worshipped by the chiefs of the other three clans; but into the scheme are drawn also other gods and chiefly ancestors. There is no elaborate mythology to explain how the ritual cycle came into being. There is a strong reverence for the ritual and the sacred objects connected with it.

The important matter of fixing the exact day on which the rites shall begin throws a significant light on the calendrical system and astronomical knowledge of Tikopia. The people have no fixed calendar and no names for the months or for the days or nights of the month. They count moons or nights of the moon for specific purposes, as in estimating pregnancy or periods between events. The term *tau*, meaning a 'measurement' or 'count', is used for a season, or sometimes a year as a whole, but without precision. Sometimes a *tau* has six months, sometimes seven. It is a seasonal period rather than a calendar period and refers primarily to the most marked climatic phenomenon in the island, namely, the alternation of the trade wind with the monsoon season. The seasonal changes, which are accompanied by changes in economic pursuits such as fishing, are the main basis for the seasonal ritual, as shown by the terms "The Work of the Trade Wind" and "The Work of the Monsoon". The trade wind begins to blow at about April and dies down in October, when the monsoon season begins.

Although the main index for the beginning is thus given by seasonal change, it is correlated with and corroborated by other factors. Though the Tikopia have no sidereal calendar, they use astronomical observation to a certain extent in time reckoning. Thus when the Pleiades rise, "the ocean has begun to bite", that is, the fish rise and are plentiful. It was said that when the Pleiades appeared above the sea in the east at dawn, it was the signal for the work of the trade wind to begin. At this time Taro, another star, stood high up at dawn. The work of the monsoon is also so guided. When Manu, a bright star, has passed the zenith in the evening, it is time to throw the firestick, for the season's work has arrived. Saraporu, another prominent star, stands midway in the western heavens in the evening at this time, but towards the end of the festival, when the dance festival begins, Saraporu has gone below the horizon. Tokens of the approach of the work of the monsoon season are also given by the migrations of birds and changes in vegetation.

The order of the rites of the Work of the Gods is traditionally fixed, though the space between them to some extent is at the discretion of the Ariki Kafika. But any ordinary Tikopia knows the sequence, and the full cycle in the traditional form shows that any man, not responsible for the organization of the rites, can carry in his memory a sequence of more than thirty days.

The Christianization of the Ariki Kafika, who took precedence over the other three chiefs in the rites, has brought about certain changes and adjustments. In the course of generations, such variation may become part of the traditionally accepted practice. This with the conseveration of other variations and causes of variation suggests the reflexion that "Polynesian culture must not be regarded as a static arrangement resting upon an original fusion of diverse elements, but as a dynamic arrangement with a tendency to variation perceptible in each generation, and with a selective process by which some at least of these variations are built into the cultural system".

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* The Work of the Gods in Tikopia. By Raymond Firth. (Published for the London School of Economics and Political Science.) Vol. 1. (Monographs on Social Anthropology, No. 1.) Pp. vi+188+3 plates. (London: Percy Lund, Humphries and Co., Ltd., 1940.) 7s. 6d.

SEVENTY YEARS AGO

NATURE, vol. 1, March 17, 1870

The Geological Calculus

In a letter under this title, [Sir] W. Boyd Dawkins, F.R.S., discusses the recent articles by Alfred Russel Wallace on the measurement of geological time. He concludes :

"But can we measure geological time by the lapse of years ? If so, we shall have solved a problem infinitely harder than that which has foiled the archæologists. Can they fix the date, say of the introduction of iron into Europe, or of the dawn of the age of bronze or of stone ? No man would venture to answer yes. . . ." If, then, we are ignorant of the dates of, say, the kings of Assyria, "which are, comparatively speaking, of yesterday, and we can simply tell that one succeeded another in a definite order, how can we reasonably expect to fix the date of any one period of the geological past ? . . . the geological 'when' merely implies before and after, while in history the idea not only of sequence, but of the lapse of how long before and how long after, can be mastered. The attempt to fathom the geological past with our short historical sounding line has up to the present time resulted merely in estimates, varying according to the assumed basis in each by thousands of centuries, that have been about as valuable in geological theory as Archbishop Usher's chronology has been found in Biblical criticism".

Sunday Lectures

A lecture delivered by Prof. T. H. Huxley in St. George's Hall, London, on Sunday, March 13, entitled "The Forefathers of the English People", is printed in full. Commenting on the occasion, a "note" reads :

"It is surely a sign of the times that we should be able to lay before our readers a scientific lecture delivered on a Sunday before a great audience, composed chiefly of the middle classes. The history—the all too short history—of English Sunday lectures is very curious and, withal, instructive. Some years ago the movement was commenced by lectures in St. Martin's Hall, which lectures, thanks to the activity displayed by 'The Lord's Day Observance Society', were brought to a close somewhat suddenly. They were afterwards revived (such is the perfection of our English law) with impunity, by the simple process of enrolling the lecturers and their friends as a religious body !" Eventually, two movements arose, the Sunday Lecture Society, and another, "emphatically the working men's movement, in which the exact programme which was at first threatened with prosecution is reproduced. Both these movements have been in operation, and have been the means of doing much good for some time past ; and no attempt has been made to interfere with that 'Free Sunday' which is of a good deal more importance to the working men of this country than even a 'Free Breakfast-table'. Surely one of those quiet victories by which each step in the march of real progress has been made good in English history has been won".

Hereditary Genius

Alfred Russel Wallace reviews at length Galton's "Hereditary Genius, an Inquiry into its Laws and Consequences". "In this book Mr. Galton proposes to show that a man's natural abilities are derived by inheritance, under exactly the same limitations as are the form and physical features of the whole organic world. Many who read it without the care and attention it requires and deserves, will admit that it is ingenious, but declare that the question is incapable of proof. Such a verdict will, however, by no means do justice to Mr. Galton's argument . . . his book will take rank as an important and valuable addition to the science of human nature".

A National History Society has just been formed at Winchester College. There is every reason to expect that the society will prove a lasting benefit to the college.

We are glad to see that meetings are being held in support of M. W. S. Allen's motion in the House of Commons to open museums on week-day evenings. We know of no argument against the experiment, and we believe the experiment would be an entirely successful one.

The Vicar of Cushendun, County Antrim, communicates the following to *Science Gossip* : "The following incident was told me the other day by a resident, who vouches for the truth of it, and which happened close to his residence in Cushendun, County Antrim. A rat, nearly white with age, and blind, was frequently seen led to the water by a young rat by means of a straw, of which the old rat held one end and the young rat the other".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Assistant Executive Engineers in the Punjab Service of Engineers, Class I—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/4A) (March 23).

Assistant Officers (Civil Engineers) in the Indian Railway Service of Engineers—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 275/1A) (March 23).

Director of Education—The Director of Education, Education Department, Newarke Street, Leicester (March 27).

Superintendent of Technical Classes under the Government of Trinidad—The Secretary (IPR/CA), Board of Education, Kingsway, W.C.2 (March 27).

Second Assistant Bacteriologist and Pathologist—The Clerk to the County Council, County Buildings, Stafford (March 28).

Vice-Principal—The Principal, Bergman Osterberg Physical Training College, Dartford (March 29).

Director of Research—The Secretary, Research Association of British Rubber Manufacturers, 105–107 Lansdowne Road, Croydon (April 6).

Education Officer—The Clerk to the London County Council, The County Hall, Westminster Bridge, S.E.1 (April 15).

Assistant Lecturer in Geography—The Registrar, The University, Manchester 13 (May 1).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health. Emergency Medical Services, Memorandum No. 5 : Oxygen Administration—Indications, Methods and Types of Apparatus. Pp. 7. (London : H.M. Stationery Office.) 2*d*. net. [262

The Case for the Immediate Introduction of a System of Family Allowances and Alternative Proposals for such a System. By Eleanor F. Rathbone. Pp. 16. (London : Family Endowment Society.) 6*d*. [262

Other Countries

Ceylon. Part 4 : Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1938. By E. Rodrigo. Pp. 98. (Colombo : Government Record Office.) 1 rupee. [262

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METHODS AND AIMS IN AMERICAN ARCHÆOLOGY

ALTHOUGH archæologists in the United States welcomed the financial assistance afforded field research and excavation by the measures taken by the Federal and State Government authorities for the relief of unemployment, their satisfaction was tempered by some misgiving. It is true that it now became possible to open up sites long marked as desirable for investigation, but of which the examination had to be postponed while the funds available were devoted to purposes of more insistent urgency in their bearing upon major archæological problems. At the same time, it was recalled to how great an extent the antiquities of the remarkable and unique indigenous civilization of the Americas had suffered from amateur and untrained trophy hunting. Further, public works were being inaugurated or accelerated which would add to the destruction on a vastly extended scale. The construction of a great dam in the Tennessee Valley during the War of 1914–18, for example, had inundated twenty-three square miles of country, and to this the projected scheme of the Tennessee Valley Authority would add a further 100 square miles, both tracts taken from a territory thickly studded with relics of Indian occupation, of which so considerable a proportion would now be lost for ever to archæological study. It was evident that there was an urgent call both for trained and skilled supervisors of excavations and public works, and for a scheme of conservation to preserve as much as was possible of the evidence of antiquity for study by posterity.

As an outcome of this apprehension, the matter was taken in hand by the National Research Council. In April 1939, the Division of Anthropology and Psychology of that body appointed a committee to study the needs of American archæology. This committee was composed of some of the most active among practising archæologists of the United States; among them were Dr. A. D. Strong, who acts as chairman, Dr. Clark Wissler, Dr. A. V. Kidder, Prof. Fay Cooper Cole, and Dr. W. S. Webb. The Committee has already published a report of a preliminary nature, of which an analysis by Dr. Carl E. Gutha, chairman of the Division of Social Sciences of the National Research Council, appeared in *Science* of December 8, 1939.

It has been pointed out recently that in the study of the indigenous civilization of the Americas, but more especially of the northern half of the continent, the distinction in method and outlook between archæological studies and ethnography and ethnology is by no means so strongly marked as it is, as a rule, in the study of Old World civilizations. On one hand, archæological methods and arguments more and more have to be applied to the reconstruction of an Indian cultural complex, while on the other hand interpretation of archæological data may be illumined by reference to the evidence of ethnography recording traditional Indian custom and belief, a source of which perhaps the fullest use has not always been made. Why Americanist studies should be peculiarly favoured in this way must be obvious. For one thing, American civilization, when once the tide of early immigrant peoples ceased to flow, remained virtually free from serious outside cultural and racial influence for some centuries—or at least so those of us would believe who are not diffusionists—until the impact of European civilization, at first of the Norsemen, though this is virtually negligible, and afterwards of other European peoples in the late fifteenth and sixteenth centuries. Further, and partly as a consequence of this prolonged isolation, American civilization shows a remarkable continuity of development, as well as a stability of condition, which has affected not merely the indigenous population but also the development of white civilization, a fact which writers on American civilization in its broader aspect have perhaps sometimes failed adequately to stress.

If we ignore the industrial zone and areas of mineral exploitation, American civilization is still based on agriculture and animal exploitation, though it is true that the place of the hunter and the bison is taken by the cowboy and vast flocks and herds of domesticated animals. Even though corn now grows in the plains where the bison once was hunted, this implies no break in the cycle of cultural development, for even as the agriculturist in the Old World has displaced the hunter, so in America the farmer has edged the herdsman off the lands which generations of wild cattle had fertilized for his crops of corn. The readiness of the early settlers and pioneers to adopt elements from indigenous culture, many of which survive to this day, bears testimony to the influence of the continental environment in moulding the technique of living from day to day.

It is evident that some such conception of the function of archæology in Americanist studies, as illustrative of a continuous development, was present in the collective mind of the Committee in deciding on the scope and in framing the terms of the preliminary report. The sphere of interest of that report, it was felt, was best limited to "an analysis of the principles which govern the methods and procedures of American archæological research" and could most usefully indicate its basic needs.

As herein formulated, the aim of American archæology is said to be "to make the past live again ; to preserve for posterity the story of the rise and spread of early cultures on the American continent and their influence on white settlement". From such studies, it is pointed out, much may be learned, not only in the field of human history, but also of such significant subjects as long-continued land utilization, cycles of climatic change and the history of important agricultural crops. It is interesting to note the implicit recognition of the fact that, given continuity of environmental and climatic conditions, an academic problem in archæology may have a practical bearing on the affairs of even such a progressive modern community as is found in contemporary American civilization.

The Committee recognizes fully that much excellent work has already been done and experience gained, as well as much valuable information gathered, through the assistance granted by Federal and State schemes for the relief of unemployment or in rescuing prehistoric records in districts about to be flooded. Yet in view of the fact that these relief projects are to be continued, and others are contemplated, it has been thought urgent that a statement should be issued at the earliest possible moment, giving the minimum requirements with which future work, whether public or private, should comply, in order to attain a standard of scientific accuracy satisfactory for the needs of archæological studies. In view of the stress laid upon general principles of archæological research and conservation, this document is of more than merely local interest.

In framing its statement of these requirements, the aim of the Committee has been to eliminate anything and everything in the nature of haphazard excavation. With this in view, it has covered every stage of the research in broad outline from its initiation, concerning which it is laid down that "a definite need should be shown for the solution of a well-defined archæological problem or for the conservation of prehistoric material placed in jeopardy by public works or other agencies, whether natural or human", down to final publication of a report which, it is insisted, should be as speedy as possible after the completion of the investigation. In regard to this latter point, however, it is emphasized that archæological investigation and 'hustle' have no affinities.

The Committee has laid down in some detail the organization for which a scientific institution or learned society must be prepared to provide when undertaking the responsibility for a research project under any one of the schemes fathered by Government authority. That responsibility cannot be regarded as ceasing with the provision of skilled archæological supervision. To this must be added the field staff, with academic training and field experience, competent to keep proper records in addition to carrying out the practical work of surveying, excavating or conducting the technical work of the laboratory, with, be it said, the complete equipment of technical apparatus, cameras, surveying instruments and the like, which each department of this work demands. A somewhat higher degree of specialization in function is power, leadership must be a question of good education and careful selection. To engage in politics in modern life and in a democracy without very hard intellectual work, great erudition and high comprehension of all divisions of science is impossible.

Scientific workers will welcome this emphasis on the importance of scientific training for those entering on political and administrative careers, but they should note also that Dr. Beneš is careful to point out that leadership demands something more than a man of analytical or reasoning capacity or scientific knowledge. Beyond intellectual ability, leadership involves decision and courage. Scientific learning or culture must be combined with keen intuition, and the capacity for rapid decision and action and for physical and moral courage.

On such leadership Dr. Beneš rests his hopes of dealing with the practical problems which democratic States must face in the immediate future: the reinforcement and consolidation of the executive power, and the development of new functions of the State; the establishment of better harmony and equilibrium between the judicial, legislative and executive organs in democratic rule; the redress of the weakness and deficiencies of the party and voting system, and the problems of nationalism and social reform. Such leadership alone will be equal to the establishment of a real and effective collective security and of a League of Nations which will afford the opportunity for such developments.

(2) "For Democracy" is a collective work. Its scope is wider in some ways than that of Dr. Beneš's book, for the first part of the book traces the development of democracy from the experience of Greece and Rome. If it has less to say about the League of Nations, like Dr. Beneš's book it includes an excellent short account of the modern totalitarian State and its dangers to freedom. Dr. Luigi Sturzo, the former leader of the Italian Popular Party, contributes a notable essay on democracy, authority and liberty, and this, with his concluding essay, on the future of democracy, is what scientific workers may find of most immediate appeal in the volume, though the significance of the deep-seated sense of unity pervading these writers—three French, two Italian, one German and one Spanish—revealed in these studies of democratic ideas and institutions seen through Catholic democratic eyes as a factor in movements towards the development of a United States of Europe should not be overlooked.

To Dr. Sturzo the spirit of democracy is freedom actuated in social life as correlative to authority, an authority in which the whole people shares, according to the capacities and position of each, in co-operation for the common good. It is in such a system that intellectual activities such as science can find their natural freedom of development, for that freedom which lies at the basis of democracy is also the life-blood of science. The main task in the defence of democracy to-day is the defence of freedom, and the defence of freedom is at the same time the defence of authority and of the social order.

In this defence Dr. Sturzo lays the main emphasis on education, involving not merely culture and training in the exercise or practice of political life but also in moral values. Intellectual or technical education alone offers no safeguards against the fanaticisms of the age, such as anti-Semitism. In this insistence on permanent moral values worthy of men and in harmony with the principles of Christianity, the book adds one more to the many which, like Middleton Murry's "The Defence of Democracy" or "The Price of Leadership", are stressing the necessity for a Christian basis of society if a new world order safeguarding the noblest traditions and ideals in man's inheritance, which democracy alone has preserved in the past, is to emerge out of the present chaos.

(3) Sir Alfred Zimmern's study is of an entirely different type. It makes its appeal to the scientific worker pre-eminently through its contribution to lucid thinking and its indication of the pitfalls and dangers which beset the study of international affairs. Sir Alfred, too, insists on the importance of moral and spiritual values. He appeals strongly for close study of international affairs by the ordinary citizen, but he stresses also the imperative necessity of clear and accurate thought if we are to realize a new world order which will adequately safeguard our heritage.

It would indeed be difficult to find a finer stimulus to such thinking than this compact little volume of cautionary wisdom. How many fatal mistakes might have been avoided had there been more scientific thought about international affairs in place of the disposition to regard the League as a short cut to Utopia, and to forget that it only marked the beginning of a new phase of world order, or that a League policy involved the participation and interests of many, not of one nation. What Sir Alfred says of the intellectual confusion due to the intrusion of religion into the discussion of problems on which religion by itself could offer no safe guidance has a bearing on many similar matters involved in the relation of science and society, the significance of which the scientific worker who reads this book can scarcely fail to appreciate.

There are indeed sections in this book in which Sir Alfred seems to be expanding the scientific method itself, and his chapters on the War of

1914–18 and its aftermath, on peace, on our English burden and on the Colonial problem could scarcely be bettered as an aid to lucid thinking about the problems of world order which will confront us after the present war. Apart from this, Sir Alfred insists that there are three necessary stages in the process leading from the prevailing anarchy to some form of world organization. Peace—the cessation of actual fighting—is only the first of these. The second is order, or what is sometimes called the stage of the hue and cry—the stage at which violence is prevented or punished by the public spirit of the citizen body, the leading democratic peoples. The third stage is that of law, where the habit of co-operation developed through common action in repressing violence has hardened into social rules for the conduct of what has then become a common social life.

The phrase "law and order" has probably been responsible, as Sir Alfred points out, for much false thinking in this sphere, and to convert it into real "order and law" should conduce to the lucidity essential in our thinking about a new world order. The scientific worker will, however, find neither here nor elsewhere in these three volumes the 'blue prints' of the world order which he in common with other lovers of truth and freedom desires. He will, however, find much that is stimulating, much that is corrective of confusion and much that should encourage him to take his own part in the travail out of which the order will be born. Nor should he be ungrateful for the evidence the volumes afford of the widely diverse fields in which men are turning their thoughts to such constructive purposes, and of the grounds for confidence in the power of democracy to prevail over the forces now threatening all that is noblest in man's moral, spiritual and intellectual heritage.

R. BRIGHTMAN.

HYDROCARBONS

Physical Constants of Hydrocarbons
Vol. 1: Paraffins, Olefins, Acetylenes, and other Aliphatic Hydrocarbons. By Gustav Egloff. (American Chemical Society Monograph Series, No. 78.) Pp. 412. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 45*s*. net.

IT has become almost a commonplace to refer to the tremendous advances which have taken place in the field of hydrocarbon research. A very large and prosperous industry has come into being almost entirely as the result of scientific research, and its leaders have realized that money must be devoted on the grand scale to such research if it is to continue to expand.

The relatively simple hydrocarbon with only two elements—carbon and hydrogen—and a straight-chain formula was almost despised not so many years ago by chemists busy unravelling the complex structures of the anthocyanins and the alkaloids, the purins and the proteins. To-day they are in the forefront of interest in many laboratories, largely as the result of the stimulus given to the exploration of the vast number of different hydrocarbons present in crude petroleum by industry's demand for new products.

For industrial purposes, fractions of the original crude of wide range of boiling point at first sufficed. Modern practice demands fractions of much smaller range, and the individual hydrocarbons are beginning to have possible technical significance. An exhaustive separation of the individual hydrocarbons is being effected as the result of co-operative research at the Bureau of Standards in Washington, and compounds which have hitherto received no attention are the object of experimentation.

The modern high-compression engine demands a special fuel with a high octane number, as the oil men term it. Straight-run or even cracked spirit alone does not suffice, and there is an indication that the fuel of the future will be a petrol re-formed from the hydrocarbons after cracking and catalysed synthesis. More and more the hydrocarbons are coming to be regarded as the primary raw materials for industrial organic syntheses.

The hydrocarbons are largely identified by four physical constants: melting point, boiling point, specific gravity and index of refraction. For a long time there has been an urgent need for a critical digest of all data pertaining to these. Such a systematic study has been going on in the laboratories of the Universal Oil Products Company in Chicago, and it is to be published in four volumes, of which the first is now before us. The first three volumes will contain the physical constants, whilst volume 4 will deal with their inter-relationships as well as correlating physical properties with structure.

The first part covers the open straight- or branched-chain hydrocarbons, namely paraffins, olefins, acetylenes and other aliphatics: they are actually grouped into ten sections. The procedure adopted is described in a short introduction and the rest of the book consists entirely of tables. Everything is very clearly printed and most easy of reference.

Dr. Egloff has long been a pioneer in research in the oil industry ; indeed I think he was one of the very first to envisage the future importance of hydrocarbons as opposed to mere oil. His knowledge of the subject is profound, and though it has been always freely made available to those who sought it privately, the fact that he has now consented to turn author is of inestimable service to every industry in which hydrocarbon chemistry plays a part. His previous work on the "Reactions of Pure Hydrocarbons" has already become indispensable to us as individuals ; his physical constants will be consulted as often in oil laboratories as is the "Oxford Dictionary" by writers.

Such a book must necessarily be costly, though the price is of no importance in industrial laboratories in relation to the utility of the book, which is of the type which does not grow out of date and will remain a standard reference book for many years to come. It is a monument to the name of Egloff.

E. F. Armstrong.

ORDNANCE AND GUNNERY

Elements of Ordnance

A Textbook for Use of Cadets of the United States Military Academy. Prepared under the direction of Lieut.-Colonel Thomas J. Hayes. (A revision of the "Textbook of Ordnance and Gunnery", by Colonel Earl McFarland.) Pp. x + 715. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 32*s*. 6*d*. net.

THIS is by no means a new book. In its present form it appeared in 1938. But like most service text-books it is a compilation which represents a more modern version of an earlier work. It is none the worse for that. On the contrary, it is well written, well and lavishly illustrated, and it is excellently produced. The index, as befits a work of reference of this extent, is full and satisfactory.

The ground covered is very wide indeed and may be briefly indicated. Three chapters on propellants, explosives and metals deal with the relative parts of physical chemistry and metallurgy. Six chapters of a more or less theoretical kind deal with internal and external ballistics, including probability, gun construction and recoil, and bombing from aeroplanes. This last indicates that the range of subjects treated is even wider than the limits which apply to the gunner. The remaining chapters, ten in number, are essentially descriptive. They cover the design of breech mechanisms, types of artillery, sights and fire control instruments, including the equipment used in conjunction with anti-aircraft artillery, gun ammunition and fuses, small arms and the corresponding ammunition, bombs and grenades ; a short chapter on the properties of light armour leads to one on mechanical vehicles. These are, in the main, tanks. Carriages are described in connexion with the corresponding types of artillery, coast defence or mobile, but the subject of tractors seems to have been dismissed more summarily. Tables at the end of the book provide useful data from physical chemistry.

The mere recital of the contents of this book should serve to show how vast is the field which lies before the modern artillerist. For all its seven hundred pages this is only an introduction to the subject, and a very good one. It is intended as a text-book for the First Class in the West Point Military Academy. As such it is supplemented by lectures and shop and laboratory practice. At once it is suggested that the U.S. cadet who is destined to find his career as a gunner leaves the Military Academy with a preparation far in advance of his opposite number in Great Britain. Whether it has been sufficiently realized that modern developments have made the subject of artillery a highly scientific branch of activity, demanding the service of the most gifted and the most highly trained brains, is a question which deserves the most serious consideration. It is not, of course, to be assumed that every young American gunner absorbs all the fare that is set before him.

For the general reader and even for some whose concern with the subject is more specialized, the most interesting and valuable chapters are probably the descriptive. Naturally, American equipment, methods of manufacture and designs are treated exclusively. But under the stress of modern rivalry the types of armament employed in different countries tend in the main to close similarity. It is in points of detail that the chief differences will be found. Against a single national point of view, moreover, a compensating advantage is to be set. There is no trace here of that atmosphere of secrecy, generally futile, on which most military authorities insist. It would, of course, be unsafe to infer that the whole of American practice is revealed without any reservation whatever. But there is a refreshing absence of that concealment which serves no useful purpose and only tends to make legitimate instruction difficult.

The chapters which deal with the mathematical theory are less satisfactory for the simple reason that they are of necessity too short to furnish more than an introduction to this aspect of the subject. They have no other noticeable fault and within their prescribed limits they are highly instructive. Thus while the account of external ballistics is so brief that the serious student will need to supplement it by consulting some at least of the standard books and original memoirs, of which a good list is appended to the chapter, the subject of yaw is treated in some detail. The effect of probability on the fall of rounds is discussed in a separate chapter. It seems curious that nowhere is the normal law of frequency more implicitly accepted than by gunners, who at the same time are very ready to reject rounds which appear to be anomalous. The inclusion of the subject of bombing from the air serves to remind the reader of the mutual relations which obtain in different countries between the army and the air force, and of the fact that the complete separation of the two forms of national defence is apt to entail some loss of a common understanding of technical problems.

Of internal ballistics it is said that "Interior ballistics is not an exact science". It is a complex problem certainly, yet the elements for its solution lie in physical chemistry and in mechanical conditions which should be capable of definition. An exact answer may not always be beyond the range of possibility. But there are two obstacles in the way. In the case of a problem which is at the same time highly complicated and of practical importance, the temptation is strong to avoid the scientific investigation of all the underlying factors and to reach the end in view, which is to predict the performance of a newly designed gun, in more summary fashion. Here, since all arsenals possess the records obtained by firing guns of many types, the empirical method of interpolation, or extrapolation, is commonly employed. But this does not mean that a more scientific treatment, in which considerable progress has already been made, can never be brought to practical perfection.

The chapter on recoil is one of the best in the book, but that on gun construction is far less satisfactory. The method of wire-winding is naturally dismissed shortly, for it has been superseded, though effective guns of this type remain in the U.S. service. The built-up gun may also be doomed to disappear. It is disappointing that the theory of auto-frettage has not been discussed at greater length, though this process of manufacture is fairly described. Both the 3-in. and the 105-mm. A.A. guns of the American service consist of an auto-fretted tube with loose-liner. But it is interesting to learn that the same service has adopted a 155-mm. howitzer which is an auto-fretted tube without liner; it is stated that this monobloc construction greatly reduces the cost and is easily replaced in the field. What steel is used in this weapon is not mentioned, and though the properties of various modern alloy steels are described no figures seem to have been given for the high elastic limits which can now be reached with increasing ease and certainty. It does not seem impossible that the process of auto-frettage with its obscure theory will go the way of other methods now abandoned, and that the gun of the future will be a simple monobloc, with or without a loose liner.

H. C. PLUMMER.

USELESS MATHEMATICS

Mathematical Recreations and Essays
By W. W. Rouse Ball. Eleventh edition, revised by H. S. M. Coxeter. Pp. xvi+418. (London: Macmillan and Co., Ltd., 1939.) 10*s*. 6*d*. net.

EVERY former reader of Rouse Ball's classic will rejoice that a new edition has been brought out. They will miss some old acquaintances, particularly the chapter on string figures, but they will find a good deal of new material, notably a chapter by Dr. Coxeter on polyhedra, and one by Mr. Sinkov on cryptography.

The book is remarkable in several respects. In the first place, although it demands no mathematical knowledge beyond elementary algebra and geometry, it brings its reader to the edge of mathematical knowledge at many points. Some of the unsolved problems treated are fundamental, such as the four-colour problem, that scandal of topology. Others, such as Kirkman's problem of the schoolgirls, will probably yield to combinatorial analysis without any revolutionary discoveries.

In the second place, almost all the mathematics is inapplicable to practice. The Admiralty staff are not likely to be presented with the problem of the three jealous husbands and the ferry-boat (p. 116) when arranging convoys, nor will the theory of mazes help the German General Staff to penetrate the Maginot Line. But parts of the chapter on polyhedra have an application to crystallography, and the theory of Latin squares has been extensively developed in connexion with agricultural tests. The most recent work on it is indeed published, paradoxically enough, in the *Annals of Eugenics.*

"Mathematical Recreations" constitutes an addendum to every mathematical library. I can imagine no better book for a schoolboy or girl who is taking mathematics seriously. The reader will find himself introduced to advanced topics such as topology, group theory, and prime number distribution theory, without any intellectual strain, and will learn a surprising amount of mathematics without knowing it. The more advanced reader will find some novelties in every chapter. Above all, one need not read the book systematically. On the contrary, it is an excellent bedside book into which one can dip at random.

The War may discourage mathematical reading. It need not. I remember that among a row of wounded officers on the deck of a barge in Mesopotamia in 1917, the occupant of the next stretcher to my own was reading Lamb's "Infinitesimal Calculus", whilst I was reading Kelland and Tait's "Introduction to Quaternions". But systematic study is certainly difficult, and perhaps "Mathematical Recreations" would have been more suitable.

I hope to see many more editions. I may be accused of attempting to gild the lily, but here are two suggestions for the next. Since the theory of Mersenne's and Fermat's numbers is part of the theory of recurring 'decimals' in the scale of 2, I should like to see an excursus on recurring decimals in the scale of 10, pointing out, for example, why every recurring decimal with a period of 10 must have 9091 or a multiple in its denominator; and since such formulæ as $\frac{1}{4}\pi = 4 \tan^{-1} 1/5 - \tan^{-1} \iota/239$ are equivalent to factorizations of $n + n\iota$, readers might be introduced to complex arithmetics on p. 348.

However, Dr. Coxeter knows his job better than I do, and has shown himself a worthy successor of Dr. Rouse Ball. This is the eleventh edition. May there never be a last edition.

J. B. S. Haldane.

GENERAL ASTRONOMY

(1) Astronomy

By William T. Skilling and Robert S. Richardson. Pp. xi+579. (London: Chapman and Hall, Ltd., 1939). 15*s*. net.

(2) Exploration du ciel

Par Pierre Rousseau. (Le roman de la science.) Pp. 256. (Paris: Hachette et Cie., 1939.) 20 francs.

(1) THE progress of astronomy, as regards both the methods and results of research, is in these days so rapid that there is always room for a new and up-to-date text-book on the subject. Messrs. Skilling and Richardson's book is the most recent of several that have appeared in the past few years; and it covers the whole field of descriptive astronomy in a simple style, suitable for the general reader.

The insertion of examination questions at the end of each chapter suggests that the work was intended to afford a complete elementary course for students. Unfortunately its usefulness for this purpose is much impaired by a certain lack of the balance which should characterize a really satisfactory text-book. Thus, while the subject of solar physics is treated in considerable detail (one of the authors being a specialist in this line of research), the planetary system is dealt with in a rather perfunctory way. The minor planets, for example, are dismissed in little more than a single page, while no mention is made of the variable rotation periods of Jupiter and Saturn, or of the transparency of the latter's ring system. On the other hand, the book certainly contains much up-to-date matter of great interest and value to the student. It is well supplied with illustrations, though some of the diagrams are open to criticism. The text appears, apart from a few minor errors and misprints, to be substantially accurate, but the so-called "glossary" at the end of the book is so abbreviated as to be practically useless.

A glance through the names of astronomers quoted in the index will reveal a certain parochialism which is rather common in American scientific books. But it is perhaps a pardonable weakness, and one from which no nation seems to be altogether immune.

(2) M. Rousseau's book consists of a series of popular essays on various aspects of modern astronomy. The author's avowed aim has been to humanize the subject and to emphasize the romantic side of research. To this end he devotes considerable space to the description of the more important astronomical instruments, and of the way in which they are actually used for various purposes. This seems to us a particularly attractive way of dealing with the subject, and M. Rousseau's obvious enthusiasm can scarcely fail to communicate itself to his readers, whether they be possessed of previous astronomical knowledge or not. The book seems worthy of something rather better than its present flimsy cover, and it is a pity that the quality of the paper has ruled out the use of half-tone illustrations.

W. H. Steavenson.

PHYSICS IN THE GLASS INDUSTRY

BY PROF. W. E. S. TURNER, F.R.S.
UNIVERSITY OF SHEFFIELD

IT is in keeping with the transparent nature of the substance that the first physical properties of glass to receive conscious study in comparatively modern times should be the optical properties. The problem of dispersion in the simple telescope lens found a partial solution in the achromatic lens combination of John Dollond in 1758, and the subsequent development of lens systems, in which the correction of chromatic aberration is still more complete, has involved the utilization of glasses of different and precisely known refractive indexes and dispersions. The work of Guinand, of Faraday, of Harcourt and of Schott was in all cases concerned with the production of better glasses of constant optical properties, or of new glasses permitting a wider range of optical properties for use in combinations.

With the work of Schott, however, there was opened up the possibility of exploiting some of the new glasses experimented with, for purposes other than components of optical instruments. Thermometer glasses of low after-contraction were one development. The accumulation of general physical data about glass had set in at Jena, so that, between about 1883 and 1895, many data were compiled about density, thermal expansion, thermal conductivity, tensile, compression and other aspects of mechanical strength ; and although in recent times some of these data have had to be drastically revised, they led to the manufacture of a variety of new glasses for heat resistant and other purposes, and pointed to the usefulness of certain compound glasses.

For the next twenty years, the impact of physics on the industry was less exciting and dramatic, but some of the results at least contained the seeds of later important developments. Then began an altogether new period in which striking individual results of physical studies led to new types such as Pyrex and other low thermal expansion glasses ; R. W. Wood's glass ; the Corex glasses, etc., side by side with the development of revolutionary processes in which highly productive automatic machinery began rapidly to displace the hand worker. The manufacture of glass bottles and containers in thousands of types ; of sheet and plate glass ; of electric light bulbs ; of glass tubing and rod and of some types of domestic glassware has within the past twenty to twenty-five years been transferred almost entirely to highly productive automatic machines, the efficient functioning of which was, in a number of cases, achieved only after many years of development.

It is in these fields of manufacture that the bulk of the capital of the industry is locked up. That represented by optical and scientific glassware of all types is relatively insignificant. The development of several of these automatic machines was in the early years in the hands of the clever mechanic, with no background of systematic knowledge of physics and chemistry, or even of the fundamental principles of engineering. It has been the service of the physicist to work out processes of control so as to maintain constant conditions under which the machine can operate favourably. As an illustration, it may be mentioned that with one automatic machine, the temperature of the molten glass (at 1140–1160° C., according to size of article to be made) in the bath from which the machine takes its own supply many times per minute, must be kept constant to ± 5° C. ; and high-temperature pyrometry, glass-level control in furnaces holding huge quantities of the molten material, and various other problems have had to be worked out suitable for each set of conditions of operation. At every stage of mass manufacture, speed and efficiency involve fundamental knowledge, and it is not surprising, therefore, that the widespread employment of physicists and chemists has really only begun with the introduction of mass manufacture.

Some conception of the part which the physicist plays both in the development of new types of glass and in the manufacturing control of others was clearly brought out during a discussion on February 15 on the subject of "Physics in the Glass Industry", held at the Royal Institution under the auspices of the London Branch of the Institute of Physics. The contributors of papers to the symposium were Dr. Harry Moore on "Strains intentionally introduced during Glass Manufacture", Dr. W. M. Hampton on "The Spectacle and Optical Glass Industry", Dr. Eric Seddon on "Physics in the Manufacture of Glass Bottles", Dr. B. P. Dudding on "Glass for Lamps and Electronic Devices", and Dr. J. H. Partridge on "Refractories used in the Glass Industry".

In the manufacture of spectacle and optical glasses, physical methods continue in the line of traditions of fifty or sixty years ago, though with some important developments. Both types of glasses must be controlled in respect of refractive index so that repeat meltings are kept within ± 0·001 of the desired value for well-annealed samples. The Pulfrich refractometer is normally employed for this control and has an accuracy of one in the fourth place of decimals on refractive index and two in the fifth on dispersion; but master standard prisms of optical glasses of refractive indexes and dispersions measured to a few units in the sixth place of decimals are used to control the Pulfrich observations. Modern optical glasses must also have a light absorption of not more than a fraction of 1 per cent per inch thickness, and the amount which occurs in the visible, ultraviolet and the infra-red has been the subject of close study and control, the main cause of absorption being the presence of very small amounts of iron oxide in solution. Spectacle glasses, on the other hand, may have colour dependent on the purpose for which they are intended, such as protective goggles for use by welders, and in all such cases the transmission in the three spectral regions must be determined as a routine control measurement.

The annealing of glass has received much detailed scientific and practical study during the past twenty years, in particular by Twyman and by Hampton in England, and by Adams and Williamson in the United States, in regard to general theory, and by English and Turner in regard to the relation of composition to the annealing temperature. The latter quantity is usually related to the viscosity, on which property of glass much work has been done in recent years. At the highest temperatures used in melting a glass, the viscosity is usually reduced to not more than 100 poises, but with fall of temperature the increase of viscosity is such that at room temperature it should be of the order of 10^{20}. The viscosity corresponding to annealing temperature conditions lies between 10^{12} and 10^{13} poises, rapid removal of strains, that is, rapid annealing, being possible at the lower viscosity figure or higher temperature, slow annealing resulting at the higher viscosity.

The annealing temperature chosen depends on the character of the glass, on its size and thickness and the degree of strain permissible. In mass-produced glass the object is to anneal as speedily as possible, and the higher annealing temperature is accordingly chosen. In modern glass bottle annealing, as illustrated by Dr. Seddon, the glassware is annealed and cooled nearly to room temperature in less than two hours. In the case of the Fourcault sheet glass process, producing an article of simple shape and uniform thickness, it is a matter of only a few minutes before the flat sheet, drawn out of a bath of molten glass at approximately 1000°, emerges from the annealing shaft at a temperature cool enough to enable it to be carried safely in the open air. On the other hand, in the case of large slabs of optical glass, it is not unusual, as Dr. Hampton pointed out, for the annealing process to involve heating them slowly from room temperature up to the annealing temperature in five to six days, to maintain them for 24–70 hours at that temperature and then to cool them during the first 150° below the annealing temperature at a rate of perhaps only 10° per day. In the case of a large telescope disk, such as the famous 200 in. disk, the cooling must be spread over several or many months.

Control of the distribution of strains in the flat-drawn sheet glass prepared either according to the original Fourcault process or its modification the Pittsburgh process, is important if excessive breakage is to be avoided. In either method, there is some contrivance whereby the edges of the sheet, which may be more than 100 in. wide and up to ¼ in. thick, are chilled and maintained rigid so soon as it is raised above the molten glass. This results in these edges being put into compression vertically as the temperature becomes uniform, whilst the centre develops tensile strain vertically, there being other tensions and compressions across and through the sheet. The tensile strains must not reach the breaking limit and must be so distributed as to leave the sheet substantially free from strain when, as is part of the normal operation, the edges are cut off. Dr. Moore described an elegant method now under trial of using Babinet compensators to maintain routine observations on the edges and centre of the sheet as it emerges from the drawing tower.

The physicist has also been set a problem by no means easy in the testing and control of 'toughened' glass produced by heating plate or sheet glass to a temperature some 50° C. above the annealing point and chilling it rapidly by a blast of cold air from many small orifices, the result being to multiply several-fold the forces which it will withstand before fracture. The compressive forces thus introduced into the surfaces are such that the glass sheet can be bent or otherwise deformed considerably before these compression strains are removed and replaced by tensile strains under which glass almost invariably breaks, since the tensile strength is only one eighth to one tenth of that of the compression strength. Here control may be exercised by a combination of mechanical testing methods and of the tensile strains measured optically either on pieces cut from lightly 'toughened' plate or on 'toughened' thick plates of glass convenient for edgewise examination.

The Babinet compensator has also been a valuable tool in the study and control of permissible stresses in vacuum-tight glass-to-metal seals in electric lamps and valves; and of flashed opal glasses, Dr. Dudding having some excellent coloured slides to show of strain patterns; whilst Dr. Hampton illustrated its use in the manufacture of bifocal lenses. In such a lens the major part consists of spectacle crown glass, into a depression of which a button of glass of higher refractive index is fused, and the whole then ground down to the required curvature. Satisfactory welding is found to require, for similarity of thermal expansion, coefficients of the two glasses to within $\pm 2 \times 10^{-7}$. Since 1920, many investigations of this property have shown that the thermal expansion–temperature curve deviates considerably from a straight line and at a transformation temperature the coefficient increases several-fold. The successful solution of the problem of obtaining two glasses, or a metallic wire and a glass, of thermal expansion curves closely agreeing with one another, is a testimony to the thoroughgoing nature of the study of this subject.

Researches on the electrical properties of glasses have had various practical applications, nowhere perhaps more vitally than in the electric lamp industry. By systematic researches on the relation of composition to electrical resistance, glasses have been made available for mercury vapour discharge lamps which will permit of their operation at temperatures of 600° and yet have a resistance 300,000 times that of the simple soda-lime-silica glasses used in 1916*, and offering prolonged resistance to blackening.

Not merely in the operations of glass fabrication and manipulation but also in auxiliary processes in its melting, modern physical methods have received valuable application. In the study of the performance of refractory articles in which glasses are melted, X-ray methods of examining structure have often led to vital knowledge; and tensile strength and creep tests at high temperatures, as Dr. Partridge showed, have been of great value.

Some fields of investigation have been but little explored by the physicist. Thus, Dr. Seddon emphasized the lack of systematic information available about certain thermal properties at high temperatures, namely, specific heat, thermal conductivity and emissivity. But sufficient has been said to demonstrate how physics has assisted in transforming glass-making into an enterprising and efficient industry.

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* See, for example, Dudding, B. P., *Proc. J. Soc. Glass Tech.*, **22**, 43 (1938).

THE FLORA OF MADAGASCAR

By Dr. J. Hutchinson,
Royal Botanic Gardens, Kew

FEW naturalists will need reminding that Madagascar, the third largest island in the world, possesses a fauna and flora of exceptional interest. Although only 260 miles distant from the nearest point on the East African coast, its flora bears an almost equal relationship with that of the great continent and that of Ceylon, Malaya and even Australia, whilst its fauna, as pointed out long ago by Alfred Russel Wallace[1], is almost exclusively related to that of Eastern Asia. Of equal interest is the fact that the language of the natives is closely related to those of Malay-Polynesia, whilst another remarkable feature is that they do not employ skins for clothing their bodies as do the natives in Africa, but make use of vegetable fibres as do the eastern peoples.

The distribution and affinities of the animal life, therefore, and of the plants in part, indicate that Madagascar was in former times connected much more closely with the continent of Asia than it is at the present day. As is well known, there are two rival hypotheses which might account for these interesting facts, either the mythical Gondwanaland of Suess, or the continental drift of Alfred Wegener. With respect to its organic life, therefore, Madagascar ranks equally with other oceanic islands such as New Guinea, New Caledonia, St. Helena and the Galapagos in being a 'museum of antiquity'.

Madagascar is nearly a thousand miles long, has an average of 250 miles in breadth and an extreme width of 360 miles. Its area is nearly four times that of England and Wales.

The main features of the island are the great central ridge of elevated ground, the encircling tropical plains, broad on the west side, narrow on the east of the ridge, and with a long girdle of primeval forest nearly 2,000 miles in length. There is fine mountain scenery in the Betsileo country in the southern portion of the island, and in the centre the Ankaratra mountains rise to a height of 9,000 ft. within a short distance of the capital, which stands at 4,000 ft. This central portion consists of rolling moor-like hills covered principally with long grass which becomes very brown and dry by the end of summer.

The flowering season of most plants in Madagascar is October–May, that is, during the rainy season. But many do not flower until December, and the grasses and sedges mostly flower towards the colder dry season, from March to May.

The plant that probably leaves the greatest impression on the visitor is the travellers' tree, *Ravenala madagascariensis* Sonn., a banana-like plant, but more closely related to the well-known South African Strelitzia than to the banana (Musa). A beautiful flowering tree is Colvillea, a leguminous plant of the family Cæsalpiniaceæ, with sensitive leaflets like those of a Mimosa, and a dense raceme a foot long of large red flowers with rounded petals.

One of the best known Madagascar herbs is Kitchingia (Crassulaceæ) (united by some botanists with Bryophyllum), which is grown in hanging baskets in our greenhouses. It commemorates the late Langley Kitching of Leeds, a missionary who collected plants in Madagascar in 1879.

Until nearly the close of the nineteenth century we knew very little of the botany of the island. The great world-exploring expeditions up to that time and to which botanical collectors were attached had mostly given it a wide berth and proceeded direct from the Cape to Indo-Malaya and Australasia, and the opening of the Suez Canal tended to increase this neglect. It was not until 1820, when Christian teaching was commenced by the London Missionary Society, that Europeans gained access to some parts of the island. A set-back soon occurred, however, for on the death of the native King Radama in 1835, missionaries were obliged to leave the country by command of Queen Rànavàlona, the native Christians were persecuted, and for many years all Europeans were excluded and foreign commerce brought almost to a standstill. In 1861, however, the island was reopened to European trade and missionary efforts recommenced, the independence of the country being more or less maintained until 1895, when it became a part of the empire of France.

Botanical exploration did not begin in earnest until about 1880, when large collections began to arrive at Kew from members of the London Missionary Society, mostly made by Mr. Langley Kitching, Dr. Parker and the Rev. R. Baron. The last-mentioned, for example, sent to Kew between the years 1880 and 1896 nearly 12,000 specimens (separate gatherings) of plants. These were dealt with by the late Dr. J. G. Baker, then principal assistant in the Kew Herbarium, and the novelties were described by him in the *Journal of Botany* and the *Journal of the Linnean Society*. To these two men, therefore, should be given the credit for laying the foundations of our knowledge of the flora. Baron's plants were particularly valuable because they were collected in the central higher parts of the island, especially the Imerina Province, and many of them proved to belong to genera and species hitherto unknown to science.

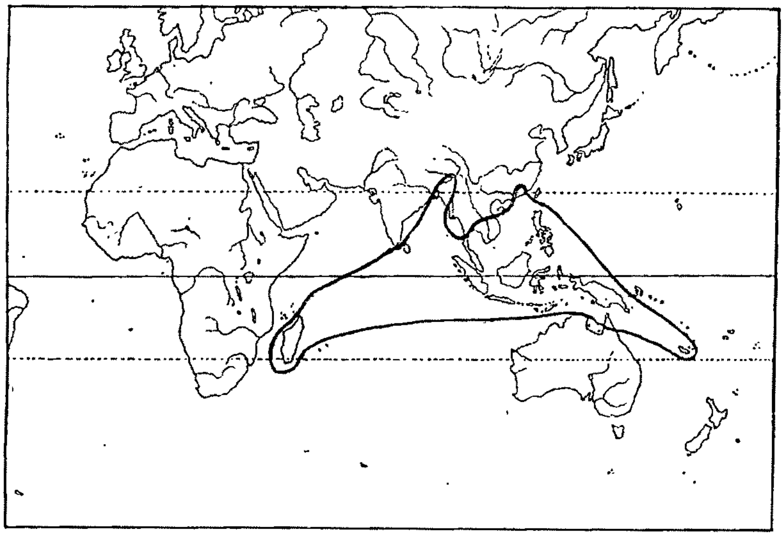
The principal British collector since Baron's time was Mr. G. F. Scott Elliot, who explored the southern part of the island in the neighbourhood of Fort Dauphin, and collected more than a thousand plants.

In more recent years large collections have been made by H. Perrier de la Bathie and by the present director of the Paris Botanical Museum, Prof. H. Humbert, and the mantle borne by Baron and Baker has very appropriately passed to the shoulders of these two French botanists. They also have brought to light many new species and new facts relating to the distribution of Madagascar plants.

In 1936 a "Flore de Madagascar" (Plantes vasculaires) was commenced under the direction of Prof. Humbert, and it would indeed be a tragedy if this important work were to be delayed because of the War. In common with other countries, after it is over, France will no doubt need as much detailed knowledge of the vegetable productions of her possessions as possible, and nothing contributes so much towards this end as a well-written and illustrated Flora such as contemplated by the Paris botanists, a portion of which has been published already[2], and further parts are in preparation.

For example, Madagascar possesses one of the most remarkable grass floras in the world, including a number of endemic genera of bamboos. Very few of them have so far been investigated for economic purposes. The soil of the plains is described as rich and very fertile and capable of supporting vast herds of cattle, and it should not be forgotten in this respect that the island is about as big as France herself. It is indeed high time that botanists should know more of the flora in a collected form, for up to the present we have only had available miscellaneous papers published in many different journals, from which it has been well-nigh impossible to obtain an adequate idea of the flora as a whole. Then, and then only, will it be possible to study the many interesting phytogeographical problems which the island presents in abundance.

I may mention only a few of the more prominent. For example, why is it that there are in Madagascar no species of Mesembryanthemum (*sensu lato*), so numerous in South Africa, when there are in the island numbers of spiny Euphorbias, Pachypodium and xerophytic Asclepiadaceæ, which are such prominent features of the South African vegetation? In addition, such typical South African genera as Halleria (a woody Scrophulariaceous



RANGE OF THE UNIQUE GENUS OF 'PITCHER PLANTS' (NEPENTHES) (AFTER HUTCHINSON: "FAMILIES OF FLOWERING PLANTS", VOL. 1).

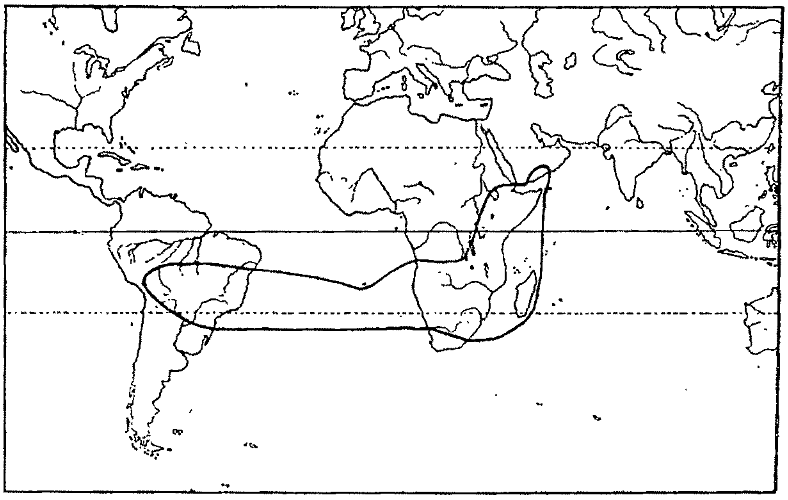
genus), Clematopsis (Ranunculaceæ), Sparrmania (Tiliaceæ), Faurea (Proteaceæ), Peddiea and Däis (Thymelaeaceæ), Kniphofia ('poker plants'), Aloe (Liliaceæ), and Aristea (Iridaceæ), are also prominent in the vegetation of Madagascar.

Again, is Madagascar the original home of the Baobab genus, Adansonia ? There are more species in the island than elsewhere, for there is only one in the whole of tropical Africa, and two in northern Australia. This connexion with Australia is mysterious and is reflected again in the case of Hibbertia (Dilleniaceæ), a large Australian genus with two endemic species in Madagascar. And how did the unique genus Nepenthes (pitcher plants) get to Madagascar, all the other species being in Ceylon and through Malaya as far as New Caledonia (see accompanying map) ? Ocean currents did not carry them ; nor did the flight of birds ; nor were the seeds borne on the wings of the wind !

Madagascar has at least two endemic families of plants. These are Chlaenaceæ, related to the great Asiatic tea family, Theaceæ, and Didieriaceæ, the latter being weird spiny plants of fantastic form and uncertain affinity, which have almost to be seen to be believed. At present we know far too little about them until they are more thoroughly investigated in the field and collected.

As stated above, the flora is only in part related to that of tropical Africa. The most striking genera common to the two regions are Brexia (Escalloniaceæ), Dombeya (Sterculiaceæ), Acridocarpus (Malpighiaceæ), Haronga (Hypericaceæ), Uapaca (Euphorbiaceæ), Myrothamnus (Myrothamnaceæ), Agauria (Ericaceæ), Psiadia (Compositæ), Landolphia (Apocynaceæ), Albizzia Sassa (Gmel.) Macbride (Mimosaceæ), and Trachylobium (Cæsalpiniaceæ), the East African copal tree, all genera or species familiar to African but unknown to Indian botanists. Most of these trees and shrubs grow in the great primeval forest which encircles the whole island at a distance of about forty miles from the coast, but which extends right to the sea at the north-west end of the island. According to Humbert, this forest is fast disappearing on account of the shifting native cultivation just as in tropical Africa, and it is of primary importance to biological science that it should be thoroughly explored and comprehensive collections made before it has been destroyed.

An interesting Madagascar-Afro-American connexion is shown by the genus Vellozia (Velloziaceæ), a distinctive monocotyledon, with shrubby stems and star-like flowers, of which there are several species in Madagascar, tropical Africa and South America, with one in southern Arabia. More surprising in this respect is the recent discovery of a new species of grass belonging to the genus Redfieldia, hitherto monotypic and known



RANGE OF THE GENUS VELLOZIA (AFTER HUTCHINSON: "FAMILIES OF FLOWERING PLANTS", VOL. 2).

only from the United States of North America. Although accepted by agrostologists, this is more likely to be due to convergent evolution such as is common in Compositæ and other large homogeneous families as Cruciferæ, Papilionaceæ, Rubiaceæ, Asclepiadaceæ, and Labiatæ. The grasses also provide a further example of the Indo-Malayan connexions of the flora, for a species of the genus Thuaria (*T. Perrieri A. Camus*), until recently known as monotypic in Indo-Malaya and Polynesia, has now been found in Madagascar.

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[1] Wallace, Alfred Russel, "Island Life", 388 (1880).

[2] "Flore de Madagascar" (Plantes vasculaires), publiée sous les auspices du gouvernment général de Madagascar et sous la direction de H. Humbert, Professeur au Museum Nationale d'Histoire Naturelle. Aponogetonaceæ, by H. Jumelle (1936); Cyperaceæ, by H. Chermezon (1937); Lemnaceæ, by H. Jumelle (1937); Commelinaceæ, by H. Perrier de la Bathie (1938); Liliaceæ, by H. Perrier de la Bathie (1938); Bignoniaceæ, by H. Perrier de la Bathie (1939). (Tananarive, Imprimerie Officielle, 1936 →).

FOOD RESEARCH

BY DR. T. F. DIXON

THE Department of Scientific and Industrial Research has recently issued the annual report for 1938 of the Food Investigation Board under the chairmanship of Sir Joseph Barcroft*. The report describes experimental work carried out under the general direction of Mr. Eric Barnard, at the Low Temperature Research Station, Cambridge, with sub-stations at Covent Garden and Smithfield, the Torry Research Station, Aberdeen, and the Ditton Laboratory, Maidstone.

The most important development during the year under review has been the expansion of the work of the Board to cover research on the processing of food. A committee has been set up to consider the organization of research in this field in the interests alike of the consumer, producer and manufacturer. As soon as research on processing is considered, the question arises as to whether it should be organized on the basis of the process, for example, canning, or of the raw material, for example, fruit and vegetables or meats. The Board takes the view that it is the research on the raw material that is fundamental.

Although some work has been already carried out on the manufacture of bacon, the smoking and salting of fish and the canning of fruit, the work of the Board had previously been mainly concentrated on the problems involved in preserving the 'fresh' properties of unprocessed food during transport and storage.

Attention is directed to the progress made in the transport of chilled beef from Australia and New Zealand by gas storage, that is, in stores on board ship the air of which is enriched to a controlled extent with carbon dioxide. Until this method of storage was developed meat could not be brought from these distant Dominions to Great Britain in a chilled condition; it had to be frozen. In the five-year period since the method was introduced, the exports to Great Britain from Australia and New Zealand of chilled beef have increased nearly ten-fold to a combined annual figure of 42,500 tons. Since chilled beef has recently commanded a premium of 1*d.* a pound over frozen beef, the increased value of this meat is of the order of £400,000. The possibility of improving the 'bloom' or appearance of the meat, which depends on the condition of the layer extending inwards to a depth of about 1/10 inch, by increasing the evaporation of water from the meat during the voyage, is also being investigated. Acidification of flesh occurring after death takes place in two stages. The first, ending at *p*H 6·2, is dependent on the physiological state of the muscle and is uninfluenced by temperature. The second stage, however, is influenced by temperature and probably represents a straightforward enzymic breakdown of glycogen. Stiffening (rigor mortis) also takes place mainly during the second stage of acidification. The higher the glycogen content at death the lower will be the muscle *p*H and the firmer the flesh. Liver and muscle glycogen levels are usually much lower in pigs than in oxen.

The average value for the ultimate *p*H (twenty-four hours or more after death) of the pig psoas muscle has been used as a measure of the muscular fatigue of the animal at the moment of death. A *p*H of 6·7 is taken as indicating extreme, and a *p*H of 5·5 or lower an absence of, fatigue. Empirically it has thus been possible to detect fatigue, ascribe the reason for it and devise methods to reduce it. The psoas muscle is more affected by fatigue and therefore almost always has a higher *p*H than the less deeply seated longissimus dorsi muscle. While the bacon pig is being fattened, an increase in the percentage of fat in the muscular tissue is accompanied by a corresponding decrease in the iodine value of the fat. By greatly reducing the plane of nutrition it has been possible to reduce the fat in muscle to as little as 0·5 per cent.

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* Report of the Food Investigation Board for the year 1938. (H.M. Stationery Office.) Pp. 277.

Experiments on the quality of the eggs laid by the hens, White Leghorn and Light Sussex, show that the percentage of thick white is primarily a characteristic of the individual hen and that there is no correlation between it and the season, the rate at which the eggs are produced or their weight. Any method of washing increases the number of rots in eggs, since the organisms responsible for rotting readily penetrate the wet shell, although the permeability of shells varies widely even in successive eggs laid by the same bird.

Work on the quality of kippers carried out for the Herring Industry Board shows that the quality of the kipper varies with the content of fat. The fatter the kipper the more palatable it is. A large proportion of the kippers made from herrings cured from February to early May would be made from herrings containing less than 8 per cent of fat. The abrupt and extensive rise in the content of the fat in June from about 2 per cent to more than 20 per cent has a peculiar effect on the suitability of the herring for kippering. The newly acquired fat is apparently held very loosely, runs away readily in the kiln, and the fish is very soft and easily torn, so that great care must be observed in curing. By July, however, consolidation of the fat has taken place and the fish make excellent kippers. The great variation in the composition of the herring makes it impossible to avoid great variation in the quality of kippers even should the process of kippering be rigidly standardized.

Electrometric and chemical methods have been used for estimating freshness of fish. With haddock, for example, estimation of either di- or trimethylamine can be used to determine the onset of definite staleness; but the course of deterioration before this stage is reached can only be followed by the determination of dimethylamine using a sensitive colorimetric method. The micro-organisms causing spoilage of salted fish known as 'pink' belong to the Serratia and Micrococcus groups. The only method so far found effective for controlling 'pink' is chilling the fish to temperatures below 5° C. During the year members of the staff of the Department's Fish Research Station at Aberdeen spent a period in Norway studying at first hand the methods employed there for the handling and storage of fish and the research on the subject in progress in that country.

During the year, arrangements were made to carry out on behalf of the Government of Palestine a survey of the wastage of oranges during transport. The temperature in the holds is an important feature in the wastage of the fruit, and the main object was to ascertain how far temperature variations were responsible for the wastage and to what extent these temperatures might be improved. Experiments were also carried out on the storage conditions of Palestinian grapefruit after its arrival in England. Further successful experiments on the gas-storage of home-grown pears, apples and broccoli have been carried out. No form of storage for apples can be reckoned successful unless it conserves their flavour, and this is especially important in the case of our finest dessert variety, Cox's Orange Pippin. A full-scale demonstration was arranged to remove any doubt in the trade as to whether this variety developed its full flavour after gas storage. Twenty-six tons of Cox's Orange Pippins were put into a gas store at the Ditton Laboratory at the end of September 1937. The composition of the atmosphere of the store was 2·5 per cent oxygen, 5 per cent carbon dioxide and 92·5 per cent nitrogen and was obtained by the removal of the excess of carbon dioxide by a scrubber of commercial design together with controlled ventilation. The temperature of storage was 4° C. The store was opened on February 22, 1938, in the presence of some 150 fruit-growers and other experts. The demonstration was completely successful, the fruit being in excellent condition; in fact 80 per cent of it was graded as 'Fancy' or 'Extra Fancy'.

On the other hand, a subsequent survey of fruit of this variety from ten representative areas has shown that the extent to which the flavour is developed depends, in the main, on the pre-storage conditions, such as soil, manurial treatment and maturity at the time of gathering. Gas-storage also lengthens the life of home-grown pears of the variety Doyenne du Comice. On removal to air after five months storage, the pears ripen in twelve days at 18·3° C. and in twenty-one days at 10° C. It is found inadvisable to store late varieties of apples together with early ripe, that is, post-climacteric varieties, since volatile substances given off by the ripe apples cause a severe 'lenticel' spotting on the other fruit not only in refrigerated gas storage but also in ordinary cold storage. This 'lenticel' spotting can be produced during storage by treating the pre-climacteric apples with ethylene (1 in 500) for 2–3 weeks early in their storage life.

Confirmation of Putterill's finding in South Africa, that ripening of the plum can be stimulated by low concentrations of acetylene, has been obtained in England for the Monarch plum. After storage for three weeks at 4° C., and removal to 18° C., stimulation of ripening by acetylene, ethylene or air which had passed over ripe plums was still possible.

Other research being carried out on behalf of the Board includes work on meat, the preparation of milk fat, the storage of eggs, bacon and hams, including the factors affecting the quality of the pig's carcass, the storage of new potatoes and other vegetables, and problems connected with canning.

OBITUARIES

Sir Hubert Murray, K.C.M.G.

BY the death, on February 27, of Sir John Hubert Plunkett Murray, lieutenant-governor and chief judicial officer of Papua, the British Empire is the poorer for an outstanding figure, and there can be few of those who came into contact with "H.E." who have not felt also a sense of personal loss.

Sir Hubert was born in Sydney in 1861, and after a brilliant university career in England, was called to the Bar. He served with distinction in the South African War; but his real life-work began when he went to British New Guinea in 1904 as chief judicial officer. When this country was placed under Australian administration as the Territory of Papua in 1906, he was appointed acting administrator and shortly afterwards lieutenant-governor. He found himself responsible for a little-known country nearly twice the size of England, populated by a thin sprinkling of white settlers and an unknown quantity of Stone Age savages.

During Sir Hubert's administration a large part of Papua has been opened up. Although as time went on his administrative duties made it necessary to delegate the work of exploration to others, he kept in personal touch with as much of the Territory as he could, and it was on a tour of inspection that he died, after two days' illness, at the age of seventy-eight. But he always regarded as his main task the guidance of the country through the difficult initial stages of adjustment. From the first, he had to contend with the clash of interests between the two types of population, "for if an administrator succeeds in holding the balance even between the white settler and the native, he is open to attack from the partisans of both, and the applause of either will often be a sign that he is acting unfairly to the other". He made it clear, however, that he considered it the duty of the Papuan Government not only to foster the interests of the whites, but also "to show how the civilization of the twentieth century can be introduced among people of the Stone Age, not only without injury to them but to their lasting benefit and permanent advancement".

Taking the long view, Sir Hubert steadily opposed the alienation of any land which appeared necessary to the welfare of the natives, and the introduction of Asiatic labour, although he faced severe criticism on the grounds that he was hampering the development of the country. To meet the reasonable demands of the white settlers for labour, he introduced the indenture system, hoping that free labour might eventually be substituted. He thought that the future of the Papuans, if they were to be more than mere labourers, lay in the cultivation of land for themselves, so he instituted a system of native plantations. He also appointed village councillors, who might gradually be given more authority. At the same time, he realized the harm that can be done to a primitive people by too swift destruction of their old life. His appointment of a Government anthropologist "to help us in reconciling an intelligent, though very backward, race to the inevitable march of civilization, and in finding the easiest way for its advance", has been amply justified.

His books, "Papua or British New Guinea" (1912) and "Papua of To-day" (1925), and his annual reports—very different from the usual lifeless documents—record, though modestly, the course of Sir Hubert's long tenure of office. Some measure of his achievement may be indicated by extracts from two addresses presented to him on the completion of the thirtieth year of his administration. This from the white residents: "Your Excellency's reputation in Native Administration is world-wide and firmly established. What is not so well known outside Papua is the patient, wise and sympathetic manner in which you have worked always for the protection and support of European industries, for the advancement of Papua as a colony, and for the welfare of every member of the community." This from the natives: "When we have come to speak to you, you have not closed your ears, nor have you frowned on us, but have received us and listened to us, and taken action for us. We have seen all the good things you have done and our happiness is great because of you. Therefore we all beg of you not to leave us, but stay here as our Governor for years to come. For we know you and how you have led us into the ways of your laws, treating white people and ourselves just the same. We know that you love us well, and we are full of love for you, our Governor." B. BLACKWOOD.

Mr. A. L. Tonnoir

BY the sudden death, on January 27, of Mr. A. L. Tonnoir, the Australian Council for Scientific and Industrial Research has suffered an irreparable loss. This loss is shared by the many entomologists throughout the Commonwealth and overseas who have from time to time benefited by his unusually wide knowledge and experience.

André Leon Tonnoir was born in Brussels in 1885. After his formal education at school and at the University of Liège, he spent several years travelling in England, France, Germany, Italy and Spain. During this period he was able to give much of his time to his outstanding interest, entomology, and incidentally to acquire a sound knowledge of six languages. However, it was not until after the War of 1914–18, when he was appointed to the staff of the Brussels Natural History Museum, that he was able to devote his whole time to his former hobby. Like many naturalists, he was especially interested in Australia and New Zealand, and in 1921 he accepted a commission to study the dipterous insects of the temperate zone of the southern hemisphere, a study which still occupied his leisure hours up to the day of his death.

From Belgium Tonnoir went to New Zealand, where he worked at the Cawthron Institute, the Canterbury Museum, and the Canterbury University College, until 1929, when he joined the staff of the Division of Economic Entomology of the Australian Council for Scientific and Industrial Research in Canberra. During the past ten years he has been closely associated with research on biological control of insect pests and weeds, and has also played a prominent part in the development of an intensive study of the grasshoppers in Australia. Mr. Tonnoir's numerous papers on lesser-known families of the Diptera do not adequately reflect his remarkable knowledge of insects, although they are a record of the thoroughness of his work and his outstanding ability as a taxonomist.

Tonnoir's death removes a colourful personality and a delightful colleague, but our sadness is tempered by the knowledge that he died as he would have wished, peacefully in his sleep as he rested in the shade of a tree, after a morning's collecting in the bush. A. J. Nicholson.

Mr. H. G. Newth

Mr. H. G. Newth, whose death at the age of fifty-four occurred on February 17 after a long illness, went to school in Worcester and then entered the Royal College of Science, London. There he studied zoology under Adam Sedgwick and Mr. Clifford Dobell, and then became demonstrator in zoology for Prof. E. W. MacBride, a post which he held until the War of 1914–18. From 1920 onwards, he was lecturer in zoology in the University of Birmingham.

The early death of Mr. Newth will be deeply regretted by his friends in zoological and other circles, for he had a personal charm which endeared him to his colleagues and his students, generations of whom remember his clear lectures and skilled help in the laboratory. Advanced students profited especially from his embryological teaching, embodying practical experimental work on modern lines.

Mr. Newth was a master of microscopical technique and was always more than willing to help other research workers in the laboratory. His own original contributions included work on the embryology of Cucumaria and of Astropecten, on the development of Amphioxus, and on the swarming of Vorticella. Perhaps his most important research was on the mode of feeding of the ammocœte, which he showed to be different from that of any other animal (Nature, 126, 94; 1930). Mucus secreted by the endostyle-thyroid is moved by cilia forwards and up the peripharyngeal grooves, from which it is freed as a cone of mucous strands, uniting behind to form a mucous cord which lies free in the middle of the pharynx. This cord is continuously sucked back into the gullet by cilia in the latter. Food particles drawn into the mouth with the respiratory water current, which is maintained by muscular movements of the pharynx and of the velum, are caught in the cone of mucous strands and passed back into the gullet in the mucous cord. H. M. F.

Prof. C. Tangl

Prof. Charles Tangl, of the University of Budapest, died on January 10 in his seventy-first year. He received his early training in physics at the University of Budapest, where he was student, and later assistant and collaborator of Prof. Eötvös. He was appointed in 1901 as *Privat-Dozent* and in 1903 as professor of experimental physics at the University of Kolozsvár. In 1917 he became professor of physics at the Polytechnic in Budapest, and in 1921 he succeeded Eötvös in the chair of experimental physics at the University of Budapest. He was a member and president of Section III of the Hungarian Academy of Science.

Tangl's interests lay in three different branches of physical research. His early work was devoted to the study of the effect of magnetic fields upon the mechanical properties of solid bodies, especially of the effect upon elasticity. Then in several papers he published the results of his investigations upon the variation of the dielectric constant of liquids with pressure and temperature. These experiments, carried out with great care and accuracy, furnished very reliable values of the dielectric constants which are frequently cited. In a third line of work he applied quite new methods to investigate the forces at the contact surface of solid and liquid bodies; the determination of the contact force between platinum and water, in particular, should be mentioned.

Tangl was a man of outstanding personality and wide knowledge. A thoroughly critical judgment was combined with great kindness; he was a helpful friend to all who needed his advice. M. Forró.

We regret to announce the following deaths:

Prof. F. Emich, emeritus professor of chemistry in the Polytechnic Institute, Graz, an authority on microchemistry, on January 22, aged seventy-nine years.

Sir Thomas Heath, K.C.B., K.C.V.O., F.R.S., an authority on Greek mathematics, on March 16, aged seventy-eight years.

Prof. A. G. Högbom, emeritus professor of geology in the University of Uppsala, on January 19, aged eighty-four years.

Prof. Bernhard Lehmann, emeritus professor of chemistry and director of the Institute of Hygiene in the University of Würzburg, on January 28, aged eighty-two years.

Prof. W. C. Morgan, professor of chemistry in the University of California at Los Angeles, on February 9, aged sixty-five years.

Dr. A. J. R. O'Brien, C.M.G., chief medical adviser to the Colonial Office, on March 9, aged fifty-six years.

NEW FELLOWS OF THE ROYAL SOCIETY

AT a meeting of the Royal Society on March 14, the following new fellows were elected:

DR. W. T. ASTBURY, reader in textile physics in the University of Leeds, distinguished for his pioneer researches into the structure of natural fibres and proteins. His chemico–X-ray technique has opened up new fields of knowledge.

DR. G. R. DE BEER, reader in embryology, University College, London, distinguished for his original contributions on the embryology of vertebrates, which are notable for their completeness and accuracy.

DR. O. M. B. BULMAN, University lecturer in palæozoology, Cambridge, distinguished for his work on Lower Palæozoic stratigraphy, especially on the morphology, ontogeny and phylogeny of the Graptolites, and their geological history.

LORD CADMAN OF SILVERDALE, chairman of the Anglo-Iranian Oil Company, emeritus professor of mining and petroleum technology, University of Birmingham, distinguished for his many public services and for his leadership—administrative and scientific—in the development of the Iranian oilfields.

PROF. G. COOK, regius professor of civil engineering and mechanics, University of Glasgow, distinguished for researches into a wide variety of engineering problems and particularly for original investigations into the stress–strain relations of metals when passing from the elastic to the plastic state under systems of combined stresses.

DR. H. DAVENPORT, lecturer in mathematics, University of Manchester, distinguished for his work in pure mathematics and particularly for his contributions to the theory of numbers.

DR. C. F. GOODEVE, reader in physical chemistry, University College, London, distinguished for his work in many branches of physical chemistry and particularly for his contributions to our knowledge of absorption spectra and photo-chemistry.

PROF. F. G. GREGORY, professor of plant physiology, Imperial College, London, distinguished for his researches on the analysis of plant growth, especially in relation to mineral nutrition and vernalization.

PROF. A. C. HARDY, professor of zoology and oceanography, University College, Hull, distinguished for his researches on marine biology and their application to fishery problems, with special reference to the ecology of the herring and the distribution of plankton.

DR. C. H. KELLAWAY, director of the Hall Institute for Medical Research, Melbourne, Australia, distinguished for his researches on snake venoms and on protective antisera.

PROF. K. S. KRISHNAN, Mahendralal Sircar research professor of physics in Calcutta, distinguished for his researches in optics, and especially for his study of the influence of magnetism on crystals.

PROF. R. P. LINSTEAD, professor of organic chemistry in Harvard University, distinguished for work in synthetic organic chemistry, including reversible isomeric change, ring compounds and phthalocyanines.

PROF. O. MAASS, MacDonald professor of physical chemistry, McGill University, Montreal, distinguished for his researches in physical chemistry, particularly those relating to the properties of gases and liquids, during which he has detected and studied an important and anomalous behaviour in the critical region.

PROF. H. S. W. MASSEY, Goldsmid professor of mathematics, University College, London, distinguished for his work in mathematical physics and particularly for his contributions to the quantum theory and its applications to physics.

DR. B. H. C. MATTHEWS, assistant director of research, physiological laboratory, and fellow of King's College, Cambridge, distinguished for his work on electrophysiology, particularly in connexion with the sense organs and the spinal cord, by which important factors in the mechanism of the nervous system have been revealed.

PROF. W. H. PEARSALL, professor of botany, University of Sheffield, distinguished for his investigations on the determination of the factors underlying the distribution of aquatic plant communities, especially in the British lakes, and on the conditions affecting algal metabolism.

DR. J. H. QUASTEL, biochemist to the Cardiff City Mental Hospital, distinguished for his work on chemical reactions in resting bacteria, the mode of action of enzymes, the chemical metabolism of the brain, and the action of drugs.

PROF. A. ROBERTSON, professor of mechanical engineering, University of Bristol, distinguished for his fundamental contributions to knowledge relating to the stability and strength of solid and tubular struts, and to many other problems in the field of the strength of materials of engineering construction.

DR. L. F. SPATH, lecturer in geology at Birkbeck College, University of London, distinguished for his researches on the phylogeny of the Nautiloidea, the goniatites and the ammonites, and particularly on the problems of ontogeny and recapitulation in cephalopods.

DR. W. SUCKSMITH, reader in magnetism, University of Bristol, distinguished for his outstanding experimental researches, particularly on the gyromagnetic effect of paramagnetics and the physical properties of ferromagnetics.

NEWS AND VIEWS

Finland and the U.S.S.R.

HOSTILITIES between these countries have ceased, and a peace has been signed which gives the U.S.S.R. substantial territorial gains. Finland loses much of her industrial and agricultural areas by this treaty, and nearly half a million of her population are being transferred from the ceded territory to other parts of Finland. The country has suffered a grievous blow, not through any lack of valour, but through the overwhelming military power of the U.S.S.R. Now the Finns have turned with characteristic courage and energy to the task of reconstruction. Towns and houses destroyed by aerial bombardment have to be rebuilt, new towns created for the transferred people, and the whole of the economic life of the country has to be restarted under the new conditions, while the defence of the new frontiers must also be organized. The Finns have saved their freedom, and on this the nation will rise again. The help in men, money and materials still so sorely needed will surely not be grudged by right-thinking peoples who have watched the struggle of this gallant democracy.

Water Pollution Research

THE Department of Scientific and Industrial Research has opened a new Water Pollution Research Laboratory at Watford equipped for work on the problems of water supply, sanitation, and the recovery and utilization of valuable materials from trade effluents of many kinds. Plans for building a research station for work of this nature have been postponed by the War, but temporary accommodation has now been obtained. Although no central research station has hitherto been available for the work of the Water Pollution Research Board, many investigations have been carried out in the last few years, on behalf of the Board, in other laboratories. Among other important work, it has been shown that certain clays and glauconitic sands found in Great Britain yield material capable of softening hard water, and that certain synthetic resins can be used to remove dissolved salts and other substances from water.

The Board has also co-operated with industry in the investigation of river pollution by beet sugar and milk factory effluents. Another important investigation was that on the effect of the discharge of sewage into the estuary of the River Mersey on the deposition of silt and other solid matter in the estuary, and an investigation is now in progress at a branch laboratory in Birmingham, in co-operation with the Birmingham Tame and Rea District Drainage Board, which has indicated that the capacity of percolating filters for treating sewage can be increased by at least 50 per cent. Communications intended for the Director of Water Pollution Research should be addressed to the Water Pollution Research Laboratory, Langley Road, Watford, Hertfordshire.

Radioactive Standards

RELIABLE standards of weak radioactivity are required in a number of fields of work; for example, by geologists, geophysicists and cosmologists concerned with the radioactive content of the materials of the earth's crust; by biological and medical investigators employing the technique of radioactive indicators or internal artificial radioactivity therapy; and in studies of radium and thorium poisoning. A committee of the United States National Research Council is endeavouring to facilitate the needs of such workers by preparing a series of feebly radioactive standards which will be analysed at a number of laboratories equipped to make such measurements. These standards will ultimately be deposited at, and certified by, the National Bureau of Standards at Washington, D.C., to be issued as working standards to investigators who may desire them.

The standards in preparation are: (1) *Radium standards*, comprising 100 c.c. solutions in sealed flasks, for use as emanation standards; and 5 c.c. solutions in sealed ampoules for use as gamma-ray standards. (2) *Thorium standards* in the form of sealed ampoules containing sublimed thorium chloride for use in preparing standard thorium solutions. (3) *Standard rock samples* consisting of a variety of finely ground minerals of certified radium and thorium content, which may be used in fusion techniques for checking methods of extracting radon and thoron from rock samples.

Drug Addiction

IN a paper read at an evening meeting of the Pharmaceutical Society on March 12, Dr. Walter B. Kennedy, a member of the Poisons Board and formerly professor of physiology in the University of Baghdad, made some interesting references to the influence of habit-forming drugs brought to his notice in the Near East and elsewhere. A topical and important aspect of drug addiction is the problem of maruanha, the name by which the hemp plant, *Cannabis sativa*, is known in the United States. Maruanha, said Dr. Kennedy, is destructive of the moral sense: "Under its influence there develops a ruthlessness rarely encountered under other conditions, and a spurious courage, or rather a complete disregard for danger and consequences which results in horrible crimes of violence—often devoid of motive. An additional danger is that the addict is often led into indulgence in the white drugs, morphine, heroin and cocaine". Another exotic drug which has lately found its way to Europe is mescal or peyote, obtained from a Mexican cactus. It is an inebriant producing even more brilliant and prolonged hallucinations than does hashish.

Dr. Kennedy referred to the excessive use of endocrine products of which evidence was seen occasionally; he mentioned in this connexion the fashion which swept through a girls' school of taking thyroid for the purpose of securing lithe figures, a fashion which had serious results in several instances. There is a wide gap between maruanha and thyroid and a still wider one between the former and aspirin. "I may surprise some," said Dr. Kennedy, "if I refer to aspirin as a drug which gives rise to habit, and without being dogmatic I would merely give my opinion that it does". Another form of addiction, he said, was provided by certain medicated wines. Many people delude themselves with the idea that when a wine was 'medicated', it was somehow free from the stigma of what is picturesquely called the 'demon drink'. But there is no excuse for maruanha and no quarrel with the penalty which may be imposed in the State of New Jersey upon traffickers in this woeful drug, namely, thirty years imprisonment and a fine of ten thousand dollars.

Twenty-five Years of Transcontinental Telephony

IT is recalled in the *Laboratories Record* of the Bell Telephone System that on January 25, 1915, just twenty-five years ago, the first transcontinental telephone call was made across America and the east and west were united. President Woodrow Wilson talked from the White House across the country testifying to the nation's pride "that this vital cord should have been stretched across America as a sample of our energy and enterprise". The inventor of the telephone, Alexander Graham Bell, in New York, repeated across the continent to San Francisco the first words ever heard over a telephone, namely, his call to his assistant, "Mr. Watson, come here, I want you," to the same T. A. Watson who had heard them in the garret workshop in Boston in 1876. That ceremony ushered in transcontinental service twenty-five years ago. At that time it cost 20.70 dollars to call San Francisco from New York. Now it costs 6.50 dollars for a station to station call and only 4.25 dollars after seven in the evening and all day on Sunday. In 1915 it took about half an hour, on the average, to make a connexion ; now most calls are put through without 'hanging up'. The Bell System concludes by saying : "These are measures of progress in the never-ending effort of the Bell System to give faster, clearer, more useful and courteous service to the people of the United States".

Development of the Battery Vehicle

IN an article contributed to the *Electrical Review* of February 16, J. H. Cansdale states that during the last six years the number of battery vehicles has been rapidly increasing, and war-time conditions will most probably create a very much greater demand for them. In 1933, the number of battery vehicles registered in Great Britain and Northern Ireland was about 1,400, and it is estimated that the number at the beginning of this present year was about 6,500. Any service with short runs and frequent stops, particularly with loads between five and thirty cwt., is suitable for the battery vehicle. A large proportion of tradesmen's and similar services in towns and suburban districts comes within this category. The great advantages of the electric vehicle in lower running and maintenance costs are now augmented by the absence of restriction on the use of electric power for battery charging, in contrast with the present petrol restrictions.

The design of modern battery vehicles has been modelled closely on automobile practice. The weight of the battery necessitates a rather heavier frame, and special provision has to be made for accommodating the battery crates and for their easy inspection and removal. Four-wheel brakes are standard, and the drive to the back axle is by means of a propeller shaft with either a double-reduction bevel or worm gear. Pneumatic tyres of the medium pressure type have been found to give the best results by combining smooth running with economical power consumption. All the principal battery manufacturers now market special traction types able to withstand vibration and to provide heavy starting currents. Of the two principal types available, the lead-acid cell is most usually employed as its first cost is less than that of the alkaline battery. On the other hand, the latter has a life of about nine or ten years, whereas a lead-acid cell lasts only three or four, so that the difference in cost is levelled out. Owing to its higher internal resistance, the alkaline cell has a lower efficiency. For the small delivery van of the 12–15 cwt. class, the normal range of battery capacities is from 129 to 290 ampere hours. Capital costs are heavier than for an equivalent motor vehicle, but the life is approximately double, and both maintenance and running costs are considerably reduced.

Indian Sculpture and Architecture

THE Madras Government Museum has recently issued two publications, one of which is a guide to the archæological galleries of the Museum and is intended as an introduction to South Indian temple architecture and sculpture, while the second contains an illustrative series of photographic reproductions of examples of Indian sculpture, mostly southern, for use with the guide ("Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti and other curators. Madras Government Press. Pp. v + 48 + 4 plates. 8 annas. "Illustrations of Indian Sculpture, mostly Southern, for use with the Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti. Pp. ii + xlv plates. Rs. 1.8). In the introductory remarks anticipating the text of the Guide, the principle is laid down that "The display of museum collections to the public aims at fostering a deep and intelligent interest in the universe of which we form a part, especially our immediate surroundings", and it is added that the arrangement and display of this section of the Museum's exhibits have been attempted in such a way as to help visitors "to recognize for themselves the general affinities and probable period of temples and sculptures they see outside". With this praiseworthy objective, the authors sketch briefly the history of Indian art from the time of Asoka and in the centuries before our era down to the 'modern' period, with abundant references to the photographs and casts illustrating the Northern Schools, as well as to the actual exhibits from those of the South, special attention necessarily being directed to the Gupta period and Amaravarti.

No stronger plea than that afforded by these guides could be put forward for the adoption of a vigorous forward policy on the educational side throughout the museums of India. As the report of the Museums Commission showed, these institutions are already places of popular resort; but it depends upon the arrangement and administration of the museum itself whether they are mere repositories of 'curios', or really serve to bring home to the people the continuity in spiritual meaning underlying objects and buildings and structures familiar to them in their daily life. In the East, the function of the archæological museum is concerned with things of which the spirit, and sometimes, if not always, the form, is still alive.

Instructional Films in India

MR. C. F. STRICKLAND has recently published a paper on "Instructional Films in India" (*J. Roy. Soc. Arts*). They supply a ready means of education in a country which "it is not possible to make literate in the next ten years", though during that period instruction concerning good government must be acquired. Adults have to be educated and already Bengal is credited with 1,000 cinemas and 500 touring companies. But most of the films shown are non-Indian and 45 per cent of them are American. They are predominantly unsuited to Indian ideas and modes of thought. Indians do not think continually "in terms of sex emotion or crime". Some educational films are now made in India and several are on loan, but these are meant chiefly for the juvenile population. Mr. Strickland explained the requirements and limitations of the Indian adult, one of which is a pace much less rapid than that to which we are accustomed. This speed with perpetual excitement is, we note, quite unnatural, lacking the tension and relaxation which prevail in life and in the best stories of action, such as the "Three Musketeers". It is, in fact, the consequent strain on the mind which makes these pictures so easily forgotten.

Totaquina

IN a recent paper (*Asiatic Res.*, 35, 777; 1939), M. Ciuca states that in its search for an anti-malarial preparation cheaper than quinine but equally efficacious, the Malaria Commission of the League of Nations instituted research into the efficacy, compared with that of quinine, of a certain number of secondary alkaloid mixtures, such as kinetum, chineto, cinchona febrifuge, etc., used in the treatment of malaria in various countries. Research carried out in more than 4,000 patients in malarious countries proved that the efficacy of preparations containing 60–80 per cent crystallizable alkaloids including 15 per cent quinine was equal to that of quinine alone. The Commission has given the name of 'Totaquina' to a new preparation which is a mixture of cinchona bark alkaloids containing at least 75 per cent crystallizable alkaloids and not less than 15 per cent quinine. The advantage of the new preparation is a distinctly lower price, which is mainly due to the method of extraction, while its efficacy is equal to or only slightly less than that of quinine.

Seeing at Night

A PAPER by R. G. Hopkinson, of the Research Laboratories, General Electric Co., Ltd., published in the *Electrical Review* of March 1, on "Seeing at Night", shows that valuable progress has been made on this important subject during the last few years, especially in connexion with black-out conditions. Under weak illumination, the response of the eye is quite different from that under normal conditions. So far as light is gathered by the lens of the eye and is brought to a focus upon the retina, it functions like a camera, the retina acting like a photographic plate in recording the scene for the brain to interpret. The retina is provided, however, with two separate kinds of receptor nerve cells, the 'cones', which usually respond to bright scenes, and the 'rods', which respond to dark scenes. In daylight the cones only function. With bright artificial light both rods and cones are working, the rods recording the shadows and the cones recording the highlights for the brain. Under black-out conditions the rods alone are functioning.

Black-out vision is much inferior to day vision for the following reasons. (1) The rods do not record colours, hence black-out vision is devoid of colour sensation; all colours appear as varying grades of black and grey. (2) There are fewer rods per unit area of the retina than there are cones. The effect is analogous to that of a newspaper reproduction of a photograph, which is made up of a number of dots and is therefore less clear than the original. This handicap is the more serious since it is just that region of the retina which normally receives the clearest image, the fovea centralis, where the rods are fewest. Hence, as many must have noticed at low illuminations, vision is often better around the periphery of the eye.

New Commercial Fruits in the United States

O. ATKINS writes in the *American Fruit Grower* (Dec. 1939) on the utility of the wild dryland blueberry (*Vaccinium vaccillans* Kalm) in relation to soil conservation. Experiments have shown that it has unusual erosion-resistant qualities on account of its underground shoots, which send out a mass of fine roots and bind the soil together over a large area. In addition to this useful property, the blue-black fruits promise to form a successful commercial crop, and as the plant will grow and fruit in partial shade or full sunlight it is well suited to 'hill-culture'. A systematic breeding programme is being undertaken by the U.S. Department of Agriculture and Soil Conservation Service.

The papaya (*Caprica papaya* L.), according to S. J. Lynch, writing in the same journal, is now being grown commercially in South Florida. The texture of the flesh is similar to that of a cantaloupe, yellow to reddish-orange in colour, with a sweet musky flavour. The fruits, which vary in size from a few ounces to 25 lb. in weight, contain 5–6 per cent of sugar, no starch, and appreciable amounts of vitamins A, B and C. The proteolytic enzyme papain, which also occurs in the fruit, is used in many commercial products as an aid to digestion. Numerous food and drink products are being made from the fruit pulp. The plant will bear for three or four years, but is treated commercially as an annual, since the finest fruit is obtained in the first year. Both monœcious and diœcious plants occur, which makes standardization difficult; but breeding work is being carried out to establish uniform strains.

Poultry Rations in War-time

COMMERCIAL poultry-rearing has reached a high state of efficiency, and part of that efficiency is expressed in a standardized ration, in which only food ingredients are used which have been proved to be best suited for their purpose. Under war conditions the accustomed standardized ration must be given up, since the amount and nature of feeding stuffs available for livestock becomes restricted, partly because of a reduction in imported supplies and partly because of the wider use of home-grown cereals for human consumption. Poultry-keepers are urged to exercise the greatest economy in the use of such imported materials as maize, and in order that the accustomed ration may be replaced by satisfactory substitutes the Ministry of Agriculture and Fisheries has issued, as one of its "Growmore" Leaflets (No. 14), a summary account of materials which may be used in rearing, growing or breeding rations. The list includes thirty-one different food materials, and the feeding value and method of using each stuff is stated briefly. Single copies of the leaflet—"Poultry Rations in War Time"—may be obtained free of charge and post paid on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Birds of the Fenland

CHANGES in the kind and distribution of the animals of the countryside which have been brought about by the progress of civilization are greater than is generally supposed, although often they are difficult to trace in detail. A short account of such changes as they have affected birds in the Fenland appears in the winter issue of *Bird Notes and News* (p. 198), the journal of the Royal Society for the Protection of Birds. In it Francis E. R. Peach, having quoted some early references to the bird-life, compares the earlier fauna with that of the present day, and shows that the general trend in the Fen area has been in the direction of a decline in ducks, geese, waders and birds of prey as drainage proceeded, and an increase in small birds such as linnets, yellow buntings and skylarks which now occupy the reclaimed marsh lands. Surely it is an omission that in dealing with the bird-history of this region the author does not refer to the invaluable "Early Annals of Ornithology", by the late J. H. Gurney, himself a Norfolk man.

Dutch Biology

A. VAN LEEUWENHOEK is known to every biologist as the name of a most eminent Dutch man of science, but we doubt whether many know that it is also the name of a worthy journal of Dutch microbiology, in spite of the fact that five volumes of it have already been published. This is in large measure due to its having appeared in the Dutch language, which has prevented its being read by more than a few English workers. We are glad to welcome its appearance in a new form. The editors and the Board of the Netherlands Society of Microbiology who are responsible for it have appreciated this difficulty, and from volume 6, No. 1, January 1940, it appears under the title *Antonie van Leeuwenhoek, Journal of Microbiology and Serology*, with English, French and German as the official languages. Thus the present number contains seven papers, five in English, one in French and one in German. Its pages are thrown open to workers of any nationality, and the editors hope that, in spite of the present inauspicious conditions, it will serve a wider public.

Demography of England and Wales

IN the third quarter of 1939, 161,201 live births were registered, or 3,119 more than the number recorded in the corresponding quarter of 1938. Of the total 6,458 were illegitimate, or 13 less than in the third quarter of 1938. The deaths numbered 103,170, and were 17,263 less than in the preceding quarter, but 568 more than in the third quarter of 1938. The mortality of infants under one year of age was equal to 39 per thousand registered live births. This rate is 8 per thousand below the average of the ten preceding third quarters and is the lowest quarterly rate ever recorded. The number of persons married in the third quarter of 1939 was 304,716, an increase of 72,084 on the number in the corresponding quarter of 1938. This number corresponds to an annual rate of 29·3 per thousand of the estimated mid-year population for 1938, and is the highest rate yet recorded.

X-Ray Photography of the Renal System

In order that X-ray photographs of the renal pelvis and ureters may be obtained, it is necessary to employ a substance which, after injection into the veins, is excreted by the kidneys and is opaque to the rays, so that a shadow picture of the excretory apparatus of the kidneys may be obtained; further, such a substance must have no harmful effect. A new preparation has been introduced by Glaxo Laboratories, Ltd., under the name of "Pyelectan", which it is stated possesses the necessary properties in marked degree. Chemically, it is the sodium salt of a complex iodine-containing dicarboxylic acid, the iodine content being 51·5 per cent. Pyelectan is claimed to have a low toxicity and to be generally well tolerated, rapidly excreted by the kidneys and yielding a dense and well-defined shadow in the renal pelvis and ureter.

Science Abstracts

THE reduction in thickness of the monthly issues of *Science Abstracts* during the last few months of 1939 will have prepared readers for a reduction of the number of abstracts in the volumes now completed for the year. Section A (Physics) contains 4,725 abstracts, a reduction of 7 per cent on the volume for 1938, and Section B (Electrical Engineering) 2,811, a very noticeable reduction of 22 per cent. Both have established for themselves international reputations as reliable records of yearly progress in the sciences with which they deal, and as indispensable to those who would keep themselves up to date.

Parliamentary and Scientific Committee

THE Earl of Dudley has been re-elected president of the Parliamentary and Scientific Committee for the year 1940. The other officers elected are: *Vice-President*, Captain S. F. Markham, M.P.; *Chairman*, Captain L. F. Plugge, M.P.; *Vice-Chairman*, Prof. B. W. Holman; *Deputy Chairman*, Mr. E. W. Salt, M.P. The Committee has recently had under consideration the question of the release from military service of certain skilled technicians and scientific workers for other work of vital national importance, and also the question of suitable employment being given to technical and scientific workers who have enrolled for military service. At the next meeting of the Executive Committee of this body the question of the collection and utilization of town refuse and waste products will be considered.

Earthquakes during February 1940

AT Kew, Basle, Chur, Zurich and Neuchâtel the registrations of earthquakes tended to show that the earth was seismologically less active than normal during February 1940. At Kew only ten notable shocks were registered during the whole month, the greatest being the three of February 7, 20, and 29. At the Swiss observatories, seventeen shocks were registered, though only nine sets of readings were sufficiently clear to obtain epicentral distances, two of these being doubtful. Distant earthquakes giving consistent readings were those of February 7, 23, and 29, the four others being much nearer to the Swiss stations. Fairly good readings were obtained at Kew for the earthquake of February 23 and at the Swiss observatories for that of February 20, but epicentral distances were not determined.

The greatest earthquakes during the month thus appear to have been those of February 7 and 29. The former, according to the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association, on the basis of reports from seventeen stations, had its epicentre near lat. 52° N., long. 174·5° E., and its initial time 17h. 15m. 56s. G.C.T., with normal depth of focus. This point is immediately to the south-east of Near Island in the Aleutian Islands group and close to the undersea escarpment, where the depth of sea quickly falls to more than seven thousand metres, according to the U.S. Geographical Society map. Although the Aleutian Islands are known to lie along a seismic belt, the region appears to have been more than normally active since the 'missing' earthquake of November 10, 1938. The earthquake of February 29, according to the Zurich seismologists, had its epicentre near lat. 45° N., long. 27° E., which is in Rumania, approximately midway between Bucharest and Galati. On the same authority the earthquake just after 1 a.m. on February 9 had its epicentre near Mont Blanc, and the earthquake of February 23 in Albania. All the above epicentral determinations are tentative.

Announcements

DR. L. E. H. WHITBY has been awarded the John Hunter Medal and Triennial Prize of the Royal College of Surgeons for his research work in "Bacteriology with special reference to the Sulphonamide Compounds".

THE office of the Royal Society has now returned to the Society's apartments in Burlington House and the library is re-opened. Communications, therefore, should be directed to the Royal Society, Burlington House, London, W.1.

THE British Association announces that the grounds of Down House, Charles Darwin's home at Downe, Kent, will be open to the public free of charge from Good Friday onward, from 10 a.m. to 6 p.m.

THE sixth Australian Medical Congress, which was to have been held at Perth, Western Australia, during September 2–7, 1940, has been postponed indefinitely.

THE herbarium of indigenous medicinal plants which is being collected at Calcutta under the ægis of the School of Tropical Medicine now contains 1,500 species, or approximately 5,000 specimens. It is hoped that when the herbarium is completed it will comprise specimens of all the 2,500 medicinal plants known to be growing in India.

DURING the first six months of 1939, 313,226 marriages took place in the old German Reich, or 10,122 (3·3 per cent) more than in the corresponding period of 1938 (303,104). In the second quarter of 1939 there were 11·2 marriages for every 1,000 inhabitants. In the same period there was a remarkable rise in the number of marriages in the former Austria, namely 28,490, or 8,921 (45·6 per cent) more than in the corresponding period of 1938. In the first half of 1939 there were 59,210 marriages in the former Austria, or 28,954 (95·7 per cent) more than in the corresponding period of 1938 (30,256).

ERRATUM.—Dr. Julian Huxley points out that the title of the substance of his British and American Association Lecture published in NATURE of March 2, p. 330, should have been "Science, War and Reconstruction".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 466. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Production of Synthetic Mycorrhiza in the Cultivated Cranberry

UNDER this title, Bain[1] describes experimental investigations on mycorrhizal relationships in *Vaccinium macrocarpon*, Ait., *V. canadense*, Kalm., and two ericaceous species, reviewing and criticizing the conclusions of earlier observers in the light of his own results. In so far as the latter relate to *Vaccinium macrocarpon*, they may be summarized as follows. A fungus, specifically distinct from those associated with the other species studied, was isolated from roots of the cranberry, *Vaccinium macrocarpon*. Identity of this fungus with that forming mycorrhizal complexes in the root cells of the host was established by inoculation of the mycelium into pure cultures of cranberry seedlings growing in nutrient agar and in 'artificial soil' composed of cork and sand.

Bain describes the colonies and mycelium of this fungus as 'specifically distinct' from those isolated by him from the other species investigated, and also from those of *Phoma radicis callunæ* obtained from the Centralbureau voor Schimmel Cultures in Baarn. Its affinities and systematic position have not been determined.

Designation and acceptance of *Phoma radicis* as the mycorrhizal associate of Vaccinium spp. and members of Ericaceæ rest on the following evidence. In 1907, Ternetz[2] reported the isolation of distinct strains of what was regarded as a single fungus species from roots of a number of native ericaceous species and from *Vaccinium Oxycoccus* and *V. Myrtillus*, all growing in Switzerland. Sporing cultures of all these fungi were submitted to Lindau and Hennings in Berlin for identification and were referred by them to the genus Phoma as a new species under the name *P. radicis*. The form associated with the European cranberry, *Vaccinium Oxycoccus*, like the others, was distinguished in culture by definite characters relating especially to the numbers of pycnidia produced, manner of fruiting, and size and shape of pycnidia and spores.

In 1915, one of us[3] reported the isolation from seeds of *Calluna vulgaris* of a fungus identical in all respects with the form of *P. radicis* described by Ternetz as the mycorrhizal associate of this plant. Subsequent observations on *Vaccinium Oxycoccus* and *V. macrocarpon* were concerned only with systemic infection of the vegetative parts and seeds; isolation of the root fungus was not attempted in either species of Vaccinium. It was tacitly assumed in this paper on Vaccinium that the mycorrhizal fungus present in roots of the native cranberry, *V. Oxycoccus*, was *Phoma radicis Oxycocci* as described by Ternetz for this species in Switzerland, and this assumption was extended to the closely similar N. American species, *V. macrocarpon*, simultaneously under observation.

Although Bain's results do not necessarily constitute a direct challenge, they introduce uncertainty, as to the correctness of Ternetz's conclusions in respect to the identity of the mycorrhizal associate of *V. Oxycoccus*, and to the validity of the subsequent tacit acceptance of this view and its extension to *V. macrocarpon*; it was evident from study of Bain's paper that a re-investigation of this matter on British material of *V. Oxycoccus* was desirable. The results of such investigation are hereby placed on record.

Freshly lifted roots of *V. Oxycoccus* were washed in running water, sterilized by immersion in 1 per cent hydrochloric acid or 0·01 per cent mercuric chloride for 15–20 seconds, and rinsed repeatedly in sterilized water. Small pieces of roots so treated were then transferred to tubes of various media, including that used by Ternetz. A majority of these platings developed pure culture colonies of greyish white mycelium, becoming pinkish brown to dark brown with age. After two to three weeks growth at room temperature, these colonies fruited, forming pycnidia of various sizes in and upon the substrate. In all respects—character of colonies and mycelium, numbers and mode of formation of pycnidia, and size and characteristics of pycnidia and pycnidiospores—this fungus resembles *Phoma radicis Oxycocci* as described by Ternetz.

We are greatly indebted to Dr. J. Ramsbottom, keeper of botany, British Museum (Natural History), for examining our cultures and confirming the identity of the root fungus isolated by us with that extracted by Ternetz from Swiss material of *V. Oxycoccus*. A similar investigation is in progress on garden material of *V. macrocarpon*.

It may be added that root material treated as described by Bain, by repeated washings in distilled water without surface sterilization, gave rise in all cases observed by us to colonies of unidentified fungi, usually yellow or orange in colour.

Full discussion of Bain's conclusions in respect to this matter and to his views respecting the nature of the mycorrhizal associations in Ericaceæ must await a convenient occasion. In justice to the pioneer observations of Ternetz, it is desired to place on record these relating to the cranberry fungus as soon as possible.

M. C. RAYNER.
IDA LEVISOHN.

Bedford College,
University of London.

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[1] Bain, Henry F., "Production of Synthetic Mycorrhiza in the Cultivated Cranberry", *J. Agric. Res.*, **55**, 811–836 (1937).

[2] Ternetz, Charlotte, "Über die Assimilation des atmosphärischen Stickstoffes durch Pilze", *Jahrb. wiss. Bot.*, **44**, 353–408 (1907).

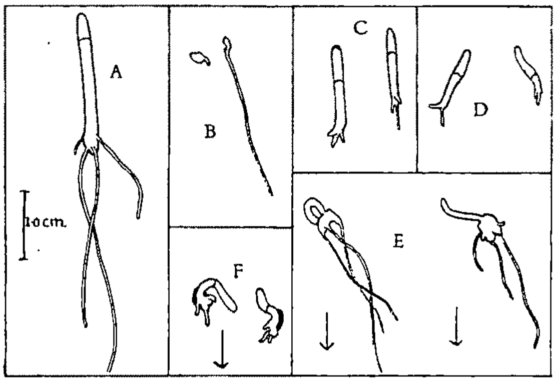
[3] Rayner, M. C., "The Biology of Fungus Infection in the Genus *Vaccinium*", *Ann. Bot.*, **43**, 55–70 (1929).

Vernalization of Fragments of Embryo Tissue

EMBRYOS of cereal grains, separated from the endosperm and cultured on a medium containing sugar, can be vernalized by exposure to a temperature of 1° C. in the same way as whole grains[1,2,3,4]. In order to locate more precisely the tissues concerned in the process, embryos of Petkus winter rye were mutilated in various ways before vernalization treatment. In this preliminary experiment only two embryos were subjected to each type of mutilation.

Treatment	No. of replicates	Condition of plants 84 days after end of treatment
A. *Vernalized* 6 *weeks*		
1. Whole embryos	7	All past anthesis.
2. Stem apex and fourth leaf retained	2	Both with ears emerged.
3. Scutellum removed	2	One vegetative, one shooting.
4. Scutellum and shoot apex removed	2	No plants obtained.
5. Scutellum and roots removed	2	One with ear emerged, one shooting.
6. Scutellum and coleoptile removed	2	One with ear emerged, one vegetative.
B. *Vernalized* 2 *weeks*		
1. Whole embryos	14	All vegetative.

The fragments were planted on agar medium containing 2 per cent sucrose, vernalized at 1° C. for six weeks, and after eight further days growth on the medium at a temperature of approximately 18° C., were large enough to be planted out. The appearance of the fragments at the end of the vernalization period is shown in the figure. The removal of the coleoptile has the curious effect of promoting hypertrophy of the tissue about the roots, and there is, in addition, a lack of gravity perception in the first leaf. Possibly the latter effect is simply due to the absence of the mechanical support of the coleoptile, but it is interesting to note that whole embryos, germinated on 2 per cent sucrose with the addition of 1/10,000 hetero-auxin solution, show a similar failure of gravitational response as well as the hypertrophy of the coleorrhiza (see accompanying figure, *F*).



CAMERA LUCIDA DRAWINGS OF EMBRYO FRAGMENTS AT END OF SIX WEEKS VERNALIZATION AT 1° C. *A*, COMPLETE EMBRYO ; *B*, STEM APEX AND FOURTH LEAF INITIAL ; *C*, SCUTELLUM REMOVED ; *D*, SCUTELLUM AND ROOTS REMOVED ; *E*, SCUTELLUM AND COLEOPTILE REMOVED ; *F*, COMPLETE EMBRYOS GROWN FOR SIX WEEKS AT 1° C. ON MEDIUM CONTAINING 1/10,000 HETERO-AUXIN (FOR COMPARISON WITH *E*. IN *E* AND *F* THE ARROW INDICATES THE DIRECTION OF THE GRAVITATIONAL PULL).

Only those embryos from which the stem apex had been removed failed to produce green plants, but their roots continued growth in the sucrose medium for many weeks. Plants arising from the isolated stem apex were dwarfed ; each consisted of a main stem and one tiller, and in one the main axis bore an ear on a stem about four inches high, with six leaves. The progress towards flowering made by each plant during 84 days from the end of vernalization is shown in the table ; no further observations were made. Comparison with plants grown from embryos vernalized for two weeks makes it clear that vernalization treatment has accelerated flowering but that the process was less effective than in the case of complete embryos.

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Permeability of Insect Cuticle

ONE of the major problems in research on insecticidal action concerns the correlation of the toxicity of an insecticide with its chemical and physical properties. Very little progress has hitherto been made when relatively non-toxic carriers have been used. This is mainly due to the fact that too little physiological significance has been attached to the mode of action of the carriers in relation to the toxic principle under investigation.

A study of the toxicities of various constituents of heavy naphtha to the nymphal and adult stages of the bed-bug, *Cimex lectularius*, L., has shown that the toxicity of unsaturated compounds, such as indene, may be materially increased by the addition of non-toxic mixtures of paraffins and cycloparaffins. The assumption that the unsaturated compound was assisted through the cuticle by the more apolar substances present in heavy naphtha led to an investigation of the general physiology and permeability of the insect cuticle. The results show that feebly dissociating compounds of high dielectric constant penetrate the cuticle much more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface. This generalization applies both to fumigant and contact action, and may be conveniently illustrated by a model experiment, using as test insects, larvæ of the blowfly, *Calliphora erythrocephala*, Meig.

When a larva is immersed in ethyl alcohol, penetration through the cuticle and tracheal system takes place very slowly, and the insect generally remains active for at least an hour. The effect of paraffins of the kerosene type is even less pronounced, and loss of reaction to a mechanical stimulus may take two hours or more. With a mixture of ethyl alcohol and paraffins, penetration of the alcohol is so rapid that the insect dies within a few seconds, swells perceptibly, and eventually bursts within four to six minutes. A peculiar swirling effect is noticeable in the region of the cuticle, which is due to the passage of water from the insect. This results in the paraffins being thrown out of solution in the immediate vicinity of the insect, and finally leads to a partial separation of the two components throughout the whole volume of the liquid, the degree of separation depending on their relative proportions in the mixture. Mechanical blockage of the spiracles does not materially affect the nature of the results.

The mechanism of penetration has been studied for the cuticles of several species of insects, and an account of this work, together with various insecticidal applications, will be published in due course.

There are two primary layers in the insect cuticle: an inner chitin layer, which consists essentially of a mixture of chitin and protein, and a thin outer lipoid layer. The present work has shown that this outer layer is relatively impermeable to polar compounds such as ethyl alcohol and acetic acid. The chitinous layer, however, is relatively permeable to both polar and apolar compounds, depending on the type of compound and the particular nature of the cuticle. The permeability of the lipoid layer to polar compounds is greatly increased by the presence of apolar substances. Thus, when a mixture of ethyl alcohol and paraffins is applied to the cuticle, the polar compound will penetrate the outer lipoid layer and then diffuse into the insect through the chitinous layer, the rate and extent of this diffusion being more pronounced than the diffusion of water in the reverse direction. In experiments on Calliphora larvæ, the insects burst before equilibrium was attained. With any particular mixture, the diffusion is governed by mutual solubilities and the pathological changes occurring in the various tissues. The permeability of the cuticle as a whole to polar compounds is increased in *both* directions by the presence of apolar substances. This increase is more pronounced in the direction lipoid layer – chitin layer, than in the opposite direction.

The relation between polarity and induced penetration of one or more substances has been worked out for a large number of compounds, and applies generally to polar substances of feebly dissociating properties, such as alcohols, fatty acids, phenols, nitrogen heterocyclic bases, ammonia, and hydrogen cyanide. Induced penetration appears to be negligible for such strongly dissociating compounds as neutral salts and mineral acids.

The results obtained are in agreement with the work of Alexandrov[1] and Morozov[2] on the permeability of the insect cuticle to various substances acting *singly*. The present work shows a close analogy with the work of Yonge[3] on the permeability of the integument lining the foregut of the decapod crustacean Homarus. So far as can be ascertained, no mechanism for induced penetration has previously been suggested. Fulton and Howard[4] have shown by injection methods that the toxicity of derris inside the insect may vary with the nature of the oil carrier used. This may be correlated with Yonge's suggestion that the permeability of the integument in the Crustacea shows a close resemblance to the permeability of the membrane of the living cell.

Bliss[5] has recently discussed the action of two poisons jointly, and has devised a classification based on relative toxicities of mixtures determined at several dosages. The present work shows that the carriers of the poisons cannot be neglected and that each constituent of a mixture may contribute to the toxicity of the whole even though it may, by itself, have no obvious toxic effect.

This statement is based on work begun under the ægis of the Medical Research Council Bed-bug Committee. Its extension is being carried out by means of a grant made to the Imperial College by the Department of Scientific and Industrial Research. I am especially indebted to Dr. N. F. Sarsfield for his assistance on the chemical side of the work.

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Chronological Sex-Ratios in Drosophila

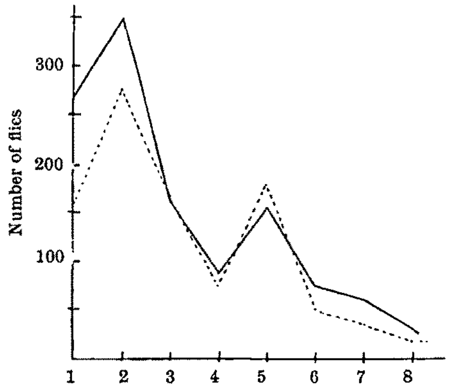
ANALYSIS of the results of observations on *Drosophila melanogaster* involving several thousands of flies substantiated previous observations in connexion with the daily variation in emerging frequency of males and females respectively of the criss-cross generation involving the sex-linked genes *y* and *w*.

Generally, cultures in which the parents were kept for forty-eight hours yielded mostly females on the first and second days of emerging. But on the fourth day of emerging the sexes evened up in numbers and on the fifth day the males outnumbered the females, the sex-ratio dropping below 50 per cent in favour of the males. The respective percentages of the total of females emerged for the first and the following seven or eight days (that is, until the culture is exhausted) were found to be approximately 30; 23; 15; 10·3; 12; 6·4; 0·5; 2; etc. The corresponding percentages of the total of males emerging were 15·7; 18·5; 15·7; 13; 24; 8·1; 2·8; 2·2; etc. (The chronological female percentages (sex-ratios) were: 68; 58; 51·5; 49·4; 36·1; 46·9; 18·2; etc.)

From these percentages it will be seen that 53 per cent of all the females and only 34 per cent of all the males emerged during the first two days. Also it will be seen that the highest percentage, namely, 24 per cent, of all males was realized on the fifth day of emerging, when the males outnumber the females. The second highest daily count of males was obtained on the second day of emerging, namely, 18·5 per cent of the total number of males. After the fifth day of emerging there was a relatively sharp decline in the number of flies emerging, reaching its lowest point on the seventh day. On the eighth day a slight arrest in this decrease was seen. From the fourth to the seventh day the males outnumbered the females. The female figures also showed a slight rise in numbers emerging on the fifth day, while an arrest in decrease seemed to occur on the eighth day of emerging.

Observations on similar lines were made on the mutant stock yellow body colour (*y*), white eyes (*w*) (see accompanying illustration). The daily percentages of the totals of emerged females and males respectively were: 22·5; 29·1; 13·6; 7·2; 13·8;

6·2; 5·0; 2·5; etc., and 16·8; 28·8; 17·2; 7·7; 18·6; 5·0; 3·7; 1·7; etc. Here the female curve also showed a high peak on the second day and another but slightly lower peak on the fifth day of emerging. This fifth day female peak was much more pronounced than that of the criss-cross generation mentioned above. The difference between the number of females and males for the fifth day was consequently not so large as in the case of the criss-cross generation.



Consecutive days of emerging
D. melanogaster (*y-w* stock)
——— ♀♀, - - - - ♂♂, n = 2143

Data treated on similar lines and obtained from observations on *Drosophila melanogaster* (wild) and *Drosophila simulans* (wild) showed a pronounced second day peak for both sexes but no fifth day peak. Hereafter there was an unarrested decline. The females were in the majority, more or less to the same degree for every day of emerging. The daily percentages of the total of females and males respectively for *Drosophila melanogaster* were: 28·7; 40·9; 19·5; 9·2; 1·1; 0·27; 0·27; and 22·8; 35·7; 26·0; 12·5; 0·6; 0·3; etc. The corresponding percentages for *Drosophila simulans* were: 18·6; 32·3; 15·7; 13·2; 8·4; 5·7; 2·8; 1·9; etc., and 11·4; 35·8; 20·0; 14·3; 8·6; 3·9; 2·6; 2·6; etc.

It is important to note that especially for the criss-cross generations involving the sex-linked genes *y* and *w*, and probably also other sex-linked genes, the sex-ratio may be inherently different from the first to the last day of emerging.

The percentage of females for the consecutive days of emerging of the criss-cross generation were: 68; 58; 51·5; 49·4; 36·1; 46·9; 18·7; 55·1; etc., the average being approximately 51·6.

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Chromosome Numbers in *Sclerostachya fusca*

Sclerostachya fusca A. Camus (*Saccharum fuscum* Roxb.) is a grass closely related to *Saccharum spontaneum* and similar to it in habit. It is distinguished from Saccharum by its rachis being tough instead of fragile and by its pedicelled spikelets being female instead of hermaphrodite. (The sessile spikelets in both are hermaphrodite.)

This grass grows in association with *Saccharum spontaneum* in Assam and Orissa. I collected several clones from both these localities in 1937. The peasants use it extensively for roofing and making framework for their mud houses, as well as for fencing. It goes by the names of *yekkada* and *ikra* in these provinces.

The Orissa form proved to have 48 chromosomes, and the Assam form, which was of larger habit, had 96 chromosomes.

Most of the Andropogoneæ, including *Saccharum officinarum*, have 10 as their basic number. Exceptions to this are Miscanthus with 36 chromosomes and the dibasic *Saccharum spontaneum* in which forms with $x = 6$ and $x = 10$ have been found.

The doubling within the species is analogous to the condition of *Saccharum spontaneum* with its west-to-east transition from 48 to 112 chromosomes[1]. The discovery of another genus, more closely related to Saccharum than Miscanthus, with the basic number of 6, makes it easier to understand the origin of the dibasic cultivated sugar canes.

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Amœba lescheri (= *Chaos lescheri*): a New Species of Amœba

EARLY in 1938 I discovered a new species of Chaos (better known as Amœba in Great Britain) which I propose to name *Chaos lescheri* = *Amœba lescheri*, to honour the memory of Mary Adela Lescher, founder of Notre Dame College, Glasgow. A full account of the life-history of this amœba will appear in the *Quarterly Journal of Microscopical Science*. The amœbæ of the genus Chaos are large and form pseudopodia that are sub-cylindrical, blunt and filled with granular endoplasm throughout. Conspicuous longitudinal ridges and grooves are characteristic of the ectoplasm. *Amœba lescheri* is readily distinguished from the other species of Chaos by its crystals, which are square prisms (maximum size 2 μ). Outsized spherical individuals attain a diameter of 525 μ, creeping individuals a length of 600 μ. The average for the former is 350 μ and for the latter 400–500 μ.

Translucency in amœbæ is a factor of age and physiological condition, depending to a large extent on the cytoplasmic inclusions. Having regard to these considerations, *Amœba lescheri* is more translucent, as it is also slightly smaller than *A. proteus* Y[1]. The shapes assumed by the contrasting amœbæ also differ, more of the bulk of the cytoplasm being concentrated in the pseudopodia of *A. lescheri*. Normally there is present one nucleus, discoid in shape. Alternate aspects of the nucleus, 'plan and elevation', are presented to the observer as the nucleus is subjected to the streaming movements of the endoplasm. Frequently the nucleus has the appearance of a biconcave lens. Since it normally lies in the peripheral endoplasm it is quickly found in a microscopical preparation of the living animal. The chromatin is distributed on an achromatic network and takes the form of regularly arranged blocks under the nuclear membrane distinct from, and slightly separated from, the rest of the network where the chromatin is not so regularly distributed.

There is one contractile vacuole (42 μ) which empties very deliberately after having moved to the posterior end. Nutritive spheres vary in size from 1 μ to 7 μ, depending on the age of the amœba, which feeds voraciously on ciliates, flagellates and rotifers. Excreta, including crystals, are gathered into a large vacuole in which a violent commotion is set up, the contents being shot explosively out of the vacuole.

A. lescheri has a marked tendency to send its pseudopodia in all directions even when more or less imprisoned under a cover slip. After having gripped the substratum and moved definitely in one direction on one, two or three pseudopodia, it loosens itself by forming radial pseudopodia and floats about. It may later return to the creeping position.

Fission of the cytoplasm may easily be observed. Spherical individuals are often binucleate. Two daughter sets of pseudopodia formed on one such floating binucleate individual indicate the onset of fission. The two daughter amœbæ use the floating debris to separate themselves as they float away. There is no thin connecting strand of protoplasm—the break is clean-cut. Under favourable conditions of environment *A. lescheri* divides once in twenty-four hours and is a good subject for 'pure-line' experiments.

One of us (Sr. C.) has investigated the cytology of the nucleus. In contrast to *A. proteus* Y. the number of nuclei never exceeds two. The average diameter is 42 μ. There is great diversity in the size of the chromatin blocks where the chromatin is more voluminous and not so immeshed in achromatic network as in *A. proteus* Y. Division in the nucleus is *amitotic*.

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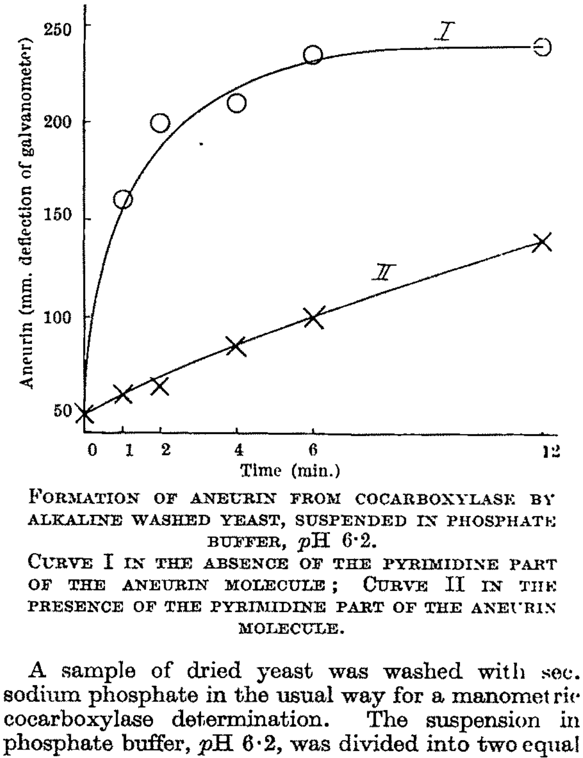
Cause of the 'Activation' of the Carboxylase System by Free Aneurin

ABOUT two years ago, Ochoa[1] made the remarkable discovery that decarboxylation of pyruvic acid by alkaline washed yeast, Mg^{++}-ions and cocarboxylase is stimulated by pure aneurin and by some derivatives of the pyrimidine part of the aneurin molecule. We have now discovered the mechanism of this stimulating action by performing some aneurin and cocarboxylase determinations by means of the thiochrome method[2]. All experiments have been carried out with baker's yeast, dried at 25° C., supplied by Distillers Co., Ltd., Epsom, with which aneurin exhibits a strong effect as compared to many other yeasts[3].

When aneurin and cocarboxylase are determined about one minute after adding cocarboxylase to a suspension of alkaline washed yeast in phosphate buffer, *p*H 6·2, a considerable part of the quantity of cocarboxylase added appears to have been converted into aneurin already. The amount of aneurin still increases rapidly during the first minutes after incubating the suspension in a bath at 28° C. From these findings some conclusions could be drawn: (1) a phosphatase, very active at *p*H 6·2, is present in alkaline washed yeast; (2) no experiment performed with this yeast, to which cocarboxylase was added, has been carried out in the absence of free aneurin; (3) the amount of cocarboxylase really acting is always much smaller than the amount added and supposed to act. These results led us to the hypothesis that Ochoa's aneurin effect might be caused by the inhibition of the phosphatase action by aneurin, namely, one of the reaction products of cocarboxylase hydrolysis. So the aneurin would not actually stimulate the carboxylase system, but only inhibit a reaction destroying cocarboxylase.

The following experiment has fully confirmed this hypothesis. As we met with some difficulties concerning the thiochrome method, when it was applied to a very large amount of aneurin in proportion to the amount of cocarboxylase present, this experiment was carried out with 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride instead of aneurin.



FORMATION OF ANEURIN FROM COCARBOXYLASE BY ALKALINE WASHED YEAST, SUSPENDED IN PHOSPHATE BUFFER, *p*H 6·2.
CURVE I IN THE ABSENCE OF THE PYRIMIDINE PART OF THE ANEURIN MOLECULE; CURVE II IN THE PRESENCE OF THE PYRIMIDINE PART OF THE ANEURIN MOLECULE.

A sample of dried yeast was washed with sec. sodium phosphate in the usual way for a manometric cocarboxylase determination. The suspension in phosphate buffer, *p*H 6·2, was divided into two equal parts. One of these parts was supplemented with an amount of 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride, giving maximal 'activation' (200 γ per 100 mgm. yeast), and both parts were allowed to react with cocarboxylase (5 γ per 100 mgm. yeast). Aneurin and cocarboxylase were determined at the times plotted in the accompanying graph. These curves, showing the velocity with which aneurin is formed, clearly demonstrate the inhibiting effect of the pyrimidine derivative on the phosphatase action. The curves showing the velocity of the decrease of the quantity of cocarboxylase are exactly the mirror-images of the curves of the accompanying graph; they are omitted to save space.

We believe we can explain all observations concerning the influence of aneurin on the carboxylase system from the point of view developed here; for example, the different sensitivity to aneurin of different kinds of washed yeast[3] (different amounts of phosphatase); the influence of the temperature of the phosphate solution used for washing the yeast[3] (destruction of phosphatase at higher temperature); Lipmann's observation[4], fully confirmed in this laboratory by Mr. Eitje and Mr. Hiegentlich, that aneurin is without any effect, when it is added to the yeast suspension some minutes after the addition of cocarboxylase (cocarboxylase destroyed already before the inhibition of phosphatase by aneurin); no stimulating effect of aneurin observable with Weil-Malherbe's purified carboxylase[5] (absence of phosphatase).

We wish to thank Prof. B. C. P. Jansen for his kind interest in our work.

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Chalk Landscape

GEOLOGISTS used to ask themselves a riddle: How did the rounded outlines of the chalk denes and downs come to show the forms characteristic of sculpture by streams, since water runs straight through the chalk and does not form streams upon it? The acceptable answer to the riddle used to be that long ago the chalk below the surface was made impermeable summer and winter by frost, and that in the spring the snows of winter rushed off the frozen surface in torrents. Weather conditions last winter in our part of Wiltshire illustrated this strikingly in a way which the oldest inhabitant does not remember to have seen before. My house is in a dene in the chalk sloping gently to the Kennet for nearly two miles, with downs on each side. It will be remembered that there was first sharp frost with heavy snow-falls, then a few days thaw, and then again sharp and prolonged frost. The effect of this, no doubt, was to seal the chalk with a layer of absorbed and frozen water. During the second and prolonged frost there was the now celebrated incessant deposition of dew in the form of ice, and of snow, making a big accumulation of water on the top of the frozen layer. Then came the final thaw. With it, for the first time within living memory, a stream appeared and flowed briskly down the dene, doing a little water sculpture on its way and leaving some tiny deposits which will make good Combe rock in the future.

How rare such an occurrence is under modern conditions is shown by the fact that my house is built in the very bottom of the dene. So it gave difficulties to the stream, out of which it could find no better way than to run straight through the house from the front door to the back.

During the second great frost the young trees were so weighted with solid ice that the tops of many were bent to the ground and old trees had great boughs broken—a strange sight but one not unseen before, for a student points out to me these passages in a letter of Erasmus:

"Deinde grando, tum et pluvia, quae simul atque terram arboremve contigit protinus in glaciem concreta est. Vidisses arbores glacie vestitas adeoque pressas ut aliae summo cacumine imum solum contingerent, aliae ramis lacerae. Jurabant nobis e rusticis homines natu grandes se simile nihil unquam in vita vidisse antea."

KENNET OF THE DENE.

Lockeridge
March 1.

Points from Foregoing Letters

A RECENTLY published account by H. F. Bain describes the isolation from unsterilized roots of *Vaccinium macrocarpon* growing in America of a mycorrhizal fungus specifically distinct from the *Phoma radicis* isolated by Ternetz from sterilized roots of native Swiss species of Vaccinium in 1907. In view of this discrepancy, M. C. Rayner and I. Levisohn have investigated British material of *Vaccinium Oxycoccus*, and now record that the fungus isolated by them from sterilized roots of this species agrees in every particular with that isolated by Ternetz.

O. N. Purvis has successfully vernalized fragments of winter rye embryos consisting of the stem apex and one leaf initial only, by culturing on a suitable medium for six weeks at 1° C. The response was less than that of whole embryos to similar treatment.

The toxicity of poisons used in insecticides depends primarily on the physico-chemical relations of the toxic principle and the carrier. H. Hurst finds that feebly dissociating compounds of high dielectric constant penetrate the cuticle of insects more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface.

Data obtained by G. Eloff in connexion with daily counts of offspring from Drosophila cultures in which parents were left for forty-eight hours, pointed in the case of the criss-cross generation to a high emerging frequency on the fifth day of counting, especially accentuated in the case of the males. In the case of pure yellow-white cultures of *D. melanogaster* the females also showed a strong fifth day peak. The phenomenon, which is probably associated with lowered viability, was absent in the case of wild cultures of *D. melanogaster* and *D. simulans*.

A new species of Amœba of the genus Chaos has been isolated and cultivated and is briefly described by M. Taylor and C. Hayes. *Amœba lescheri* is slightly smaller than *Amœba proteus* Y., which it resembles in many ways. The nucleus, which is discoid and situated in the peripheral endoplasm, divides amitotically. Fission of the cytoplasm can take place while the amœba floats and occurs once a day.

H. G. K. Westenbrink and D. A. van Dorp have investigated the cause of the apparent activation of the carboxylase system by free aneurin. In their opinion it is caused by the inhibitory effect of aneurin on the hydrolysis of cocarboxylase by phosphatase, present in the alkaline washed yeast.

RESEARCH ITEMS

Rostro-Carinate Stone Implement from Rhodesia

Implement-bearing talus on the lower slopes of the Gwelo Kopje, Southern Rhodesia, known for some years to students of Rhodesian prehistory as the source of a sequence of stone implements in which flake implements are associated with *coups de poing*, has now produced an undoubted rostro-carinate which is described by Neville Jones (*Trans. Rhodesia Sci. Assoc.*, 37; 1939). The implement is of special interest as it is the best example of the form as yet found in Southern Rhodesia, and its occurrence in a deposit which contains no evidence of fracture from natural causes after deposition gives added weight to the claim for the human manufacture of this type of implement. It is the only unmistakable rostro-carinate found at Gwelo. The form is characteristic in that it is fairly symmetrical and broadest at the posterior end, from which it tapers to a sharp point, which imparts to it a beak-like appearance. The ventral surface is unflaked and presents the natural weathering. Parallel with this is the small dorsal platform, originally triangular, from the apex of which the keel begins and extends to the top of the 'beak'. The sharp-edged keel is strongly curved in elevation, fairly true to the median line and is slightly sinuous in plan. It is formed by the removal of a wide flake on each side. The weight is 1 lb. 6 oz. Though there is no evidence of comparative age, it may be claimed, from analogous finds at Hope Fountain, to be a tool of early type.

Studies of American Cities and States

A study of American cities and States by methods which have proved valuable in the study of individual persons has been published by E. L. Thorndike (*Annals N.Y. Acad. Sci.*, 39, 213–298; 1939). Variations and correlations in institutions, activities and the personal qualities of the residents have been obtained for each city in the United States having a population of more than 30,000 in 1930, but excluding the cities of more than 500,000, except Milwaukee, and the three resort cities, Atlantic City, Miami and St. Petersburg. The 296 different items examined covered population and growth, value of public property, literacy, expenditure on public services, sales and prices, rents, salaries, mortality figures and vital statistics, occupational data, membership of institutions, etc. The data show very great variation in important features of life and welfare, and for each city and State composite scores have been computed which may be used as indexes, respectively, of the general goodness of life for good people in the community in question, the *per capita* income of its residents and their personal qualities of intelligence, morality and care for their families.

Growth and Feeding of Young Herring

S. M. Marshall, A. G. Nicholls and A. P. Orr have continued their studies on the growth and feeding of young herring in the Clyde (*J. Marine Biol. Assoc.*, 23, 1939). The last paper dealt with growth from spawning to metamorphosis; the present paper gives the results of an attempt to continue the work from metamorphosis up to the formation of the first winter ring. Two distinct groups were met with. The first, obtained during July 1936–May 1937, were caught inshore; the second, of which only a few catches were taken, in 1937 and 1938, were caught offshore. The second group is shown to be of the same origin as those discussed in the previous paper. Details are given of counts of vertebræ and lengths for race determination, size and growth, weight, chemical composition and food. A series of hauls made over a night showed that the herrings were most abundant inshore at dusk and dawn and contained most food during 7–11 p.m. The food was examined throughout the year and compared with the plankton hauls. Copepods, as is usually found, formed the main diet, but other organisms were at times plentiful, coinciding with their abundance in the plankton. Thus when cirripede larvæ were common in the plankton, the stomachs were full of them; this was also the case with Cyphonautes. With Calanus it was different, this copepod being frequently common in the gut and quite absent from the accompanying plankton hauls, which suggests that the herring had been feeding offshore before they were caught, although the presence of typical littoral plankton shows that they fed inshore as well. In general the results of the food investigation agree with those of other workers.

Amphibian Anatomy

Various features of the skeletal elements of the skull, hyoid apparatus and vertebral column of the Amphibia have been employed for the purpose of systematic diagnosis. In a recent paper, L. S. Ramaswami (*Proc. Ind. Acad. Sci.*, 10; 1939) has critically examined these as recorded in previous literature and in the light of his own considerable experience in five genera of anurous Amphibia. He has already published a series of detailed observations on this subject (1932–37), and the present paper serves in some respects as a summary of these. A number of criteria previously used are shown to be of no use, and the author concludes with a detailed list of the characters that can be used in the Ranidæ, Rhaophoridæ (Polypedatidæ), Microhylidæ, Bufonidæ and Pelobatidæ.

A New Species of Rose

The expedition of Captain F. Kingdon Ward to Tibet in 1924 resulted in the introduction of several rose species to European horticulture. One of these, No. 6101, was provisionally named *Rosa Sweginzowii* var. *inermis*, but Mr. B. O. Mulligan, who has examined several shrubs now in cultivation in England, considers it to be a new species, which he has named *R. Wardii* (*J. Roy. Hort. Soc.*, 65, Pt. 2; February 1940). A full diagnosis is given. The rose is attractive from a garden point of view, bearing white flowers with striking red centres.

Filterable Viruses

A useful review of the filterable viruses of animals and plants has recently been published by L. J. Davis (*Proc. Rhodesia Sci. Assoc.*, 37; September 1939). Consideration is given to modern findings under the various headings of filtration, microscopy, possible culture, pathology and host relations, chemical composition, and resistance to inhibiting agents. Perhaps the most interesting section, however, is that on the nature of viruses. The question "Are they Animal ?" is dismissed somewhat summarily, and the evidence as to their vegetable or mineral nature leads to the general conclusion that "viruses, or at least some of them, while manifesting the properties of living matter may actually occur in a form never before known to be compatible with life, a kind of non-cellular life".

Bacteriophage and Plant Lysins

THE origin of the mysterious bacteriophage, the transmissible agent which dissolves living bacteria, has never been accounted for. It was discovered by Twort and arises spontaneously in cultures of bacteria under certain conditions. D'Herelle maintains that it is a living ultra-microscopic agent, others believe that it is a chemical agent, capable of regeneration, analogous to a plant virus. In a paper communicated to the American Association for the Advancement of Science at Columbus, Ohio, in December last, Roy C. Thomas suggests a possible mode of origin. He finds that a non-specific lysin or 'dissolving' agent is found in many plants. It is inactivated by heating to 56° C. for thirty minutes, and has much the same action upon bacteria that bacteriophage has. When this lysin comes into contact with bacteria susceptible to its action, a change occurs resulting in the formation of a transmissible lytic principle similar to bacteriophage ; it is not inactivated at 60° and only partially at 65°. It is suggested that this is the origin of the bacteriophage, at least in plants. With regard to corn wilt bacteria, with which much work was done, a bacteriophage can be obtained for any strain which does not contain one, and a phage developed for a culture is highly specific for it.

Fluorescence of Diacetyl

KALLE (*Naturwiss.*, 25, 61 ; 1937) observed that when aqueous diacetyl is irradiated with violet or near ultra-violet light it exhibits a vivid green fluorescence which increases from zero to a constant saturation intensity. Almy, Fuller and Kinzer (*J. Chem. Phys.*, 8, 37 ; 1940) have shown that this delay is caused by the quenching action of dissolved oxygen which is ultimately consumed. On outgassing, the fluorescence appears immediately in its full intensity. Oxygen and carbon dioxide quench the fluorescence temporarily. They also found that diacetyl vapour exhibits fluorescence. The fluorescence spectra of both are identical with that of acetone excited by 3130 A., but, in contrast to diacetyl, the fluorescence of acetone rises gradually from zero intensity. This is explained by assuming that the fluorescing molecule in both instances is diacetyl. The fluorescence of acetone will then grow in intensity as the concentration of diacetyl in it increases. Further, acetone is excited by 3130 A., which does not affect diacetyl. This is considered due to the formation of diacetyl molecules excited by collisions of the second kind, diacetyl with excited acetone molecules, or by a three-body collision of diacetyl with two combining radicals. The fluorescence spectrum of diacetyl was found insensitive to changes in diacetyl pressure (0·1–50 mm.), temperature (10°–100°), and exciting wave-length (3650–4358 A.). The ratio of intensity of fluorescence to light absorbed is independent of the pressure, and the intensity is linearly proportional to the exciting intensity at constant pressure. The quenching of fluorescence by oxygen follows the Stern-Volmer law over the range in which the fluorescence falls to 20 per cent of the initial intensity ; at higher pressures the intensity falls more rapidly than is expected. The life-time of the fluorescing molecule is estimated as 10^{-5} sec.

Insulation Stresses in Transformers

A PAPER read by J. L. Thomas to the Institution of Electrical Engineers on February 22 discusses the stresses in the insulation of transformers, with special reference to surges and electrostatic shielding. The normal working voltage per turn on even the largest transformer is not likely to exceed about 100 volts. Hence the amount of inter-turn insulation required for normal working conditions is ample when compared with the minimum considered necessary mechanically. The established standards of high-voltage tests, which originally had an empirical origin, have resulted in major insulation proving itself generally adequate by satisfactory service records even in districts subject to severe lightning. At the present time, the principal application of 'non-resonating' shielding is in connexion with transformers for exceptionally high voltages of 220 kv. and above. The mathematical theory shows that the effect of the shielding is to reduce the space harmonics, and in particular the higher harmonics, and so to reduce the peak voltage gradients. Oscillograms are shown of a large number of tests on the effects of shielding. In all cases the shields have been shown to effect a substantial improvement. Results are given of tests on a three-phase 88 kv.–8,000 kva. transformer in oil. The large effects produced by 'chopped' impulses on inter-coil voltage transformer windings with and without shields are shown. The author shows that shielded winding makes possible an economical design in which it can be ensured that inter-cell failure under impulse conditions will not occur before major insulation breakdown.

Meteor Observations from India

MOHD. A. R. KHAN, Begumpet, Deccan, has sent an account of his observations of meteors in 1939. Altogether he recorded the paths of 1,233 meteors and these included members of some of the major showers. The maximum display of Orionids was attained on October 19, a total of eight being observed between 21h. 30m. and 22h. 30m. ; on October 17 only two were seen and on October 18 five. Two of the latter were very bright, with magnitudes – 1 and – 2·5. On November 13, 27 meteors were observed between 22h. and 23h. but only 5 of these were Leonids. On November 14, out of 13 meteors observed from 20h. 45m. to 21h. 30m., there was one Leonid, and on the following night during watches extending over 1h. 15m., out of 8 meteors there were 5 Leonids. On November 16, during a watch of 45m., a total of 30 meteors was observed, 5 of which were Leonids. On December 12, in a watch of 2h. 10m., a total of 74 meteors was seen, 15 of which were Geminids. Although most of these were faint, as is usual with this shower, there were three bright meteors, of magnitudes 1, 0, and – 3 respectively. On December 14 watch was maintained for 1h. 20m., and 10 Geminids were observed, 4 of which were fairly bright. Careful watches were kept on October 9 at different times for Giacobinids, but none was seen ; on the following night clouds rendered observations useless.

INDIAN SCIENCE CONGRESS ASSOCIATION

MADRAS MEETING

THE DECCAN TRAPS: AN EPISODE OF THE TERTIARY ERA

AT the dawn of the Tertiary era, vast outpourings of basaltic lavas covered immense regions in the north-western United States, in the old Thulean province which extended from Greenland to Scotland and Ireland, and in the Deccan. In estimating the exact geological age of these lavas, much depends on the interpretation of the fossils (chiefly plants) from interbedded sedimentary deposits. Recent work on the interbasaltic flora of the Hebrides was summarized by Sir Albert Seward in his presidential address to the British Association at Dundee in 1939, and now Prof. B. Sahni, presiding at the twenty-seventh Indian Science Congress held in Madras during January 2–8, has discussed the Inter-Trappean flora of the Deccan.

Fissure eruptions, Prof. Sahni thinks, may once have spread sheets of lava over some half million square miles, and even after continuous erosion for millions of years the Deccan Traps still cover an area of 200,000 square miles. Thickest along the west coast (six to ten thousand feet), their abrupt ending gives no measure of their extension over a tract of land that foundered into the Arabian Sea.

The flora is known mainly from sediments in the Nagpur and Chhindwara districts of the Central Provinces, occurring between some of the lowest and oldest flows in the whole series; the plant-bearing beds at Rajahmundry on the east coast are also low in the series. No Inter-Trappean beds have yet been discovered in the middle part, and the lava-flows may have issued in such rapid succession that there was no time for extensive colonization or deposition of sediments. (The plant-bearing beds of western Scotland are also found between some of the basal flows.) At Bombay Island the upper members of the Deccan Traps include sedimentary beds yielding a pigmy frog and other organic remains, but no plants have yet been recorded. The highest Traps are in places covered by marine beds of known Eocene age, which fixes an upper limit for the age of the series.

The view that the Traps were poured out during the Cretaceous is not supported by the fossils. One of the most conclusive single pieces of evidence is the occurrence of fruits belonging to the brackish-water stemless palm Nipa, a plant characteristic of Eocene beds at many points near the shores of the former Tethys Sea, for example, in the London and Paris basins, in Poland, southern Russia and Egypt. The palms, known from numerous fruits as well as from abundant petrified wood, dominated the Inter-Trappean flora; although this family arose in the Cretaceous period, it did not become prominent until after the Tertiary era had begun. The abundant charophyte fruits support an early Tertiary age, while the water-ferns, unknown from pre-Tertiary rocks, are represented by a beautifully preserved Azolla.

Numerous other elements in the flora are of botanical rather than geological importance; they include fungi belonging to the Perisporiaceæ and Sordariaceæ, many types of spores, and various dicotyledonous fruits.

GALACTIC DYNAMICS

For his presidential address in the Section of Mathematics, Prof. A. C. Banerji chose as his subject "The Development of Galactic Dynamics and Some Allied Problems". Under this heading was considered a wide selection of the mathematical researches that have been made into the effects of rotation on gravitating masses.

The survey began with the classical researches concerning the stability of spheroids and ellipsoids of uniform density, and went on to a discussion of the pear-shaped figure, while the later work of Jeans on the analogous behaviour when the mass is compressible was also touched upon. The possibility of extending the treatment to the case of a fluid under more general physical conditions led to the recent investigations by Milne, Bhatnagar and others on the distortions that a fairly small rotation would cause in polytrophic distributions, and in particular Chandrasekhar's results for double stars. The work by Eddington in which any spherical distribution can be discussed by means of a variable polytropic index was considered next and reference was made to the special feature of this method, that many properties are intermediate between the corresponding properties of the two spheres whose polytropic indexes are the extreme values of the variable polytropic index.

Turning to the problem of rotating nebulæ of galactic dimensions, the discussion was commenced by describing Hubble's classification of the various observed types. Before proceeding to the problem presented by the spiral arms of nebulæ, the difficulties found by Jeans concerning the impossibility of the formation of stars in an equilibrium configuration of a nebula were brought forward. As for the theories of the spiral forms of the arms, Jeans's point-mass model was considered first to demonstrate the difficulty that the existence of stars is incompatible with the necessary gaseous structure of the nebulæ. The results obtained by E. W. Brown that spiral arms could persist for long periods only under very artificial systems of forces were quoted next, and in the same category were taken the more speculative suggestions of Vogt and Lambrecht postulating cosmical repulsion in the galaxies. Proceeding to our own galaxy, it was suggested that the differential rotation may be an indication of instability in the outer regions.

Arising out of the question of the formation of spiral arms, Prof. Banerji said that it is first necessary to decide whether in Newton's second law the impressed force is proportional to the mass times the acceleration *or* to the rate of change of momentum, and various opinions on this point were cited. The existence of interstellar matter and its possible dynamical effects completed the account given of galactic problems.

In conclusion, Prof. Banerji referred to the recent advances in the theory of the origin of the solar system. It was explained how the former difficulties relating to angular momentum had been resolved by Lyttleton, starting with the hypothesis that the planets were formed from a companion star to the sun during an encounter with an intruding star.

The effects of tidal friction in bringing about some of the detailed features of the solar system were briefly discussed, as, for example, the suggestion that the slow rotation of Venus can be explained by supposing that Mercury was formerly a satellite of this planet, and that the retrograde satellite of Neptune arose as a result of an encounter between two direct satellites, of which one escaped as an independent small planet (Pluto), and the other was diverted into a retrograde orbit.

MAGNETIC STUDIES OF AROMATIC MOLECULES

Prof. K. S. Krishnan delivered the presidential address to the Section of Physics, taking as his subject "The Diamagnetism of the Mobile Electrons in Aromatic Molecules".

Prof. Krishnan pointed out that our knowledge of aromatic molecules, particularly benzene, has been extended very considerably during the last few years by the quantum-mechanical treatment of the linkages and valency electrons and by the experimental determination of the symmetry and normal modes of vibration by means of infra-red and Raman spectra. It is now known that in benzene one electron of each carbon atom is mobile and can move from carbon to carbon, conferring on the molecule magnetic properties somewhat similar to those of free electrons in metals.

Outlines were given of the theories of paramagnetism of an electron gas and of diamagnetism of a free-electron gas; and the experimental data on graphite were reviewed with special reference to the temperature variation of magnetic anisotropy. These data verify Landau's view that quantization of the motion of free electrons in the magnetic field leads to a balancing between the diamagnetic and paramagnetic contributions, and that the temperature-independent diamagnetism of the free-electron gas is one third of its paramagnetism.

Mobile electrons in aromatic molecules are free to move anywhere in the ring; this is the same as postulating resonance between canonical structures, five of which are required for benzene, whilst for naphthalene 42 and for anthracene (or phenanthrene) 429 are necessary. Mobile electrons in aromatic molecules give rise to abnormal diamagnetism in the direction perpendicular to the plane of the ring and, consequently, to large diamagnetic anisotropies. For single crystals of such magnetically anisotropic molecules, if the magnetic constants are known, orientations of the molecules in the crystal lattice can be deduced, or, conversely, if molecular orientations are known from X-ray data, the principal magnetic constants of the molecules can be calculated. This calculation supports the theory when applied to sixteen aromatic molecules, and the contribution of mobile electrons is approximately proportional to the number of benzene rings in the molecule. These mobile electrons also give rise to optical effects, fluorescence and absorption, in both of which it is the component parallel to the molecular plane which is active. Not only are mobile electrons associated with benzene rings, but also with other conjugated ring structures, for example, cyanuric trichloride and phthalocyanine.

The address concluded with a brief consideration of theoretical calculations of the magnitude of diamagnetic anisotropies.

ROLE OF CHEMISTRY IN FORESTRY

Dr. S. Krishna, presiding over the Section of Chemistry, covered a wide range of topics in his address upon the role of chemistry in forestry. His topic is very suitable to current conditions, as it directs attention to the many ways in which Indian sources of supply, of drugs, dyes, tanning material and the raw material for many industries might be drawn upon, with increased income for the country and a diminished demand for imports. The work of the chemist was reviewed in connexion with production, conservation and utilization, but perhaps the main emphasis was placed upon the latter.

Very interesting Indian examples were cited of differences in chemical constitution and of economic importance, which had remained unrecognized by the systematist. In the Kurram valley (North-West Frontier Province) two varieties of *Artemisia maritima* grow side by side, one of which yields nearly 2 per cent of santonin but the other has none; only later was it noted that the young plants of the valuable forms had reddish stems, while the others were green at this stage. Four varieties of *Eucalyptus dives* exist, morphologically indistinguishable, but yielding oils with piperitone content ranging from 5 to 50 per cent. In connexion with seasoning, problems of timber impregnation were discussed, and attention was also directed to the recent Russian experiments using ultra-short waves.

Considerable attention was given to the possibility of increasing forest revenue by greater utilization of minor products. Baluchistan forests, run at a deficit for more than thirty years, have recently become solvent on the sale of Ephedra. Although many minor products would not repay harvesting on a large scale, they may have possibilities if organized on the lines of 'cottage industries'. Amongst minor 'forest' products, grasses and bamboos have supplied most revenue, particularly for the production of the better grades of paper. Another minor product available to prevent present imports is turpentine, now obtained from the oleoresin of *Pinus longifolia*. This is not so rich in pinene content as the turpentine from other species of pines such as *P. excelsa*; when such sources are tapped, they would be available for conversion into camphor, at present wholly imported.

Dr. Krishna advocated the formation of an association to stimulate the cultivation and utilization of medicinal plants in India, in order to promote the utilization of India's very valuable drugs, sources of many of which are found in India's forests.

THE UPPER CRETACEOUS AND LOWER EOCENE

Prof. L. Rama Rao, in his presidential address to the Section of Geology, took as his subject "Recent Advances in our Knowledge of the Upper Cretaceous and Lower Eocene Beds of India, with special reference to the Cretaceous-Eocene Boundary".

During the past few years several geologists, working in various parts of India, have made material contributions to our knowledge of the stratigraphy and palæontology of the uppermost Cretaceous and Lower Eocene rocks of this region. Much new light has thus been thrown upon the position and nature of the Cretaceous-Eocene boundary and upon questions of palæogeography.

The Ranikot beds, long ago recognized as the basal division of the Eocene in Sind, have been shown to be of pre-Ypresian age. They are now known to be much more widely distributed than was formerly supposed, occurring also in the North-West Frontier Province, the Salt Range, Kashmir, Tibet, Burma, and western Iran. In the Samana Range (North-West Frontier Province) the Hangu Shale, with its rich fauna, seems to constitute the lowest fossiliferous horizon of this formation anywhere known; it is separated from Upper Cretaceous deposits by a conformable series of beds which, however, have yielded no fossils. A similar transition from the Cretaceous to the Eocene seems also to exist in Burma and possibly in Tibet.

In the Peninsular area interesting discoveries of fossils have recently been made in beds intercalated in and underlying the Deccan Trap; their study has led to the conclusion that the Trap belongs to the Lower Eocene rather than to the Cretaceous, as formerly supposed. The well-known Infra-Trappean bed of Rajahmundry would appear to lie almost upon the border-line between the Cretaceous and the Eocene. Prof. Rama Rao's own researches have led to the important new discovery of Lower Eocene beds overlying the Cretaceous in the Pondicherry district. Especial reference was made to the study of the fossil algæ of many of the rocks under discussion, as this work is proving of great help in their correlation.

In discussing, next, the geography of early Eocene times, Prof. Rama Rao visualizes, in the west, an arm of the ancestral Indian Ocean stretching northward so as to cover Sind, Baluchistan, parts of the Punjab, the North-West Frontier Province, and Kashmir; and dividing, in the north, into two branches, which extended respectively to Iran and Tibet. A second arm of this sea, situated to the east of India, extended northward into parts of Assam and Burma. Reference was made to the divergent views of various authorities as to whether there was direct communication with the Mediterranean Sea of that period.

In his concluding remarks, Prof. Rama Rao pointed out that the great geographical changes which heralded the incoming of Tertiary times must everywhere have affected the balance of marine life; hence a normally evolving succession of forms may not have persisted even in those parts of the sea where sedimentation was uninterrupted.

GEOGRAPHY IN NATIONAL PLANNING

The Section of Geography and Geodesy was formed on the occasion of the Jubilee meeting at Calcutta in January 1938, when its sessions were attended by a strong delegation from Britain. The president this year of the Section was Dr. S. P. Chatterjee, and in his presidential address he directed attention to the part which should be played by geographical studies in national planning.

A stock-taking of resources on a provincial basis is an essential pre-requisite of any work of national reconstruction, and that there is no country in the world where there is a greater need of a detailed land utilization survey than India. The assertions that in Bengal, which is selected for study as Dr. Chatterjee's native province, the land is deteriorating, soils losing fertility, marshes and lakes increasing in area at the cost of good arable lands, and river-borne sediment failing to build up the land, all require substantiation. The official statistics, skilfully shown in cartographic form, show that only one third of British India (contrasted with nearly half of 'Indian' India) is actually cropped. In Bengal, which in places supports a *rural* population, albeit in a condition very near the starvation level, of a thousand persons per square mile, no less than one quarter of the whole province is classed as fallow and cultivable waste, whilst less than half is actually cropped.

Dr. Chatterjee has clearly appreciated his training both in the French school and in Britain, and has attacked the problem on a regional basis. He gives the preliminary results of a survey carried out in the past two years and suggests a division of Bengal into ten regions. As frequently happens, the local cultivators know and appreciate small differences in soil and the local names (mainly based on texture) have been used to divide the new alluvium into ten types the distribution of which is shown on an instructive map.

As Chatterjee says, "since national planning means a conscious effort of man to change his environment in the best national interest, it is rational to be equipped with a thorough and accurate knowledge of the type, historic growth and present distribution of the various factors that go to form our cultural landscape, which is the subject matter of geography", and on this basis he appeals for an All-India organization for conducting a geographical survey.

(To be continued)

AIR CIRCULATION OVER INDIA

A MEMOIR of the India Meteorological Department (26, Part 10) by K. R. Ramanathan and K. P. Ramakrishnan, entitled "The General Circulation of the Atmosphere over India and its Neighbourhood", is probably the most complete account that has yet appeared of the average winds and temperatures in the upper atmosphere over India in each month of the year.

The observations of upper wind made with the aid of pilot balloons at observatories, and those of cloud movement, together with the measurements of temperature aloft by sounding balloon made at Agra, Poona and Hyderabad, form the basis of the discussion. Mean isotherms for various levels up to 6 km. were obtained partly from the changes of wind with height, from which the mean magnitudes and directions of the temperature gradients were calculated, and partly from the mean temperatures at the different heights for the three upper air observatories, supplemented in some cases by temperatures measured at Peshawur or Quetta. Although in theory it is sufficient, having obtained a chart of temperature gradient, to have the vertical distribution of temperature at only a single station in order to be able to draw the absolute values of the isotherms, in practice, the computations being only approximate at every stage, the accuracy of the final picture was increased by having means of temperature at several places.

The results are set out in 74 plates, the mean air movement being taken up to 8 km. The main features of the upper wind and temperature distribution in the different months are discussed and then summarized (pp. 192–207). The most striking feature of the circulation is the regular seasonable movement of the upper wind system, which in the summer half of the year is from south-east to north-west and back, and in the remainder of the year is mainly from north to south and back. The smallness of the month to month movement from December to April or May is taken to signify that cooling and heating of the ground over India by radiation does not greatly modify the circulation, the big changes being caused by the northward penetration and the subsequent retreat of moist air from the southern hemisphere with its attendant rainfall.

Other striking features brought out by this study are the modifying influence of the Himalayas up to a height of 6 km., and the fact that regions of heavy rainfall become regions of high temperature and divergence of air movement above 6 km. The mean winds derived from cloud movement have a much larger northward component than those derived from pilot balloons, which last require absence of cloud so that the balloon can be followed. A true picture of average conditions cannot therefore be obtained from either method alone.

ECONOMICS OF WAR-TIME EXPORT TRADE

A VALUABLE broadsheet "Exports in War" issued by Political and Economic Planning (P E P) reviews the question in relation to the economics of war and the principles upon which the export policy of Great Britain should be based. The object of exporting at all is to save man-hours, and in war-time to avoid mortgaging the future by the sale of overseas securities. Because of our limited ability to pay for imports in exports or foreign securities and our restricted capacity to ship them over, there must be discrimination between different types of demand for imports, giving priority to those which are most urgent from the point of view of winning the war.

The broadsheet stresses the basic importance of applied intelligence in exports; in war, it is particularly important to concentrate on those goods the selling price of which includes least matter and most mind, and the seller's market which is being created by the War should be utilized to grade up export industries instead of clinging to older and less profitable lines. Similarly, every opportunity missed of improving productive efficiency is a drag on the national effort. If new layers of demand are continually tapped and labour and capital progressively transferred to more and more advanced processes or products, the shrinkage of formerly important export industries can be faced without dismay. Moreover, if we make the inter-allied economic arrangements between France and Great Britain work effectively, we shall not only have won the war but made also the greatest possible contribution towards winning the peace.

These agreements between France and Great Britain are outstanding among the actual War-time economic measures. With the joint committees on economic co-operation covering the supply and purchase of munitions, food and raw materials, shipping policy and economic warfare, they should lead to one economic policy for the two countries. This is specially true of exports. The three major elements in any export policy are the export potential, the available markets and the foreign trade policies. The nature of the export potential is the most important in a sellers' market, but exports cannot be left to take care of themselves after the needs of the armed forces and of the civilian population have been met, but must be recognized as a priority of the first importance. Among the opportunities for expansion of our exports at present, the broadsheet stresses those in machinery to complete unfinished German contracts, and those in cotton textiles, locomotives and coal.

The effect of the contraband control on export policy must next be recognized. The purpose of such control is to impede the supply of vital commodities to the enemy. This has now been extended to exports, so that Germany's direct overseas trade should soon be virtually destroyed. Particularly in Latin America, the control has created new markets for Great Britain, and for this our bargaining position is in general strong.

The second aspect of economic warfare consists in the extension of the effects of the blockade to the Continent, so as to cripple Germany's trade with those neutrals with whom contact can still be maintained. The object of promoting British exports to European countries is to turn the tide of trade heavily against Germany by raising the prices of neutral products. This involves a careful study of the strategy of economic warfare, if Germany is to be prevented from importing from neighbouring countries. Strategic purchases, for example, of Rumanian oil involve British exports to pay for them. Sound export policies, moreover, can only be framed after the fullest information about markets and resources has been obtained, and such policy covers every aspect of exporting from production to marketing, including the use of bilateral or multilateral methods of approach to markets, import or export subsidies.

A large-scale purchasing programme makes a survey of the export potential more urgent, and the existence of these Anglo-French programmes is an important factor for world producers. Overseas Governments will require to know that resources are available to supply the necessary goods if they are to continue to sell to Britain, and also that exports have priority over alternative demands. The importance of paying sufficient attention to the needs of the non-self-governing colonies is stressed in the broadsheet, which adds one further plea to the many already advanced for a co-ordinator of trade policy with sufficient political status, including access to the Cabinet, to secure the full and coherent use of Great Britain's immense resources for acting as a centre of world economic expansion.

PRODUCER GAS FOR MOTOR VEHICLES

THE recently published "Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas" (London : H.M. Stationery Office, 1940. 9*d*. net) conveys conclusions only. The Committee, set up by the Mines Department in May 1937, carried out extensive experimental work, including bench tests and road tests under normal operation and under scientifically controlled conditions, from which it can be inferred that a considerable body of quantitative information was derived. The data, however, have not been published; presumably it was not desirable to give details of the work at the present time.

Road trials with commercial producers showed that, subject to certain inherent limitations, producer gas is a satisfactory fuel for transport vehicles. The Committee was impressed by the difficulties encountered and the special conditions attending such an emergency as was envisaged, and therefore undertook the design of a simple producer which would be suitable for the conversion of existing vehicles, capable of rapid production at low cost and required only such metals, plant and labour as were likely to be available in war-time.

Although on the Continent considerable numbers of vehicles have been operated by producer gas, the small amount of progress made in Great Britain is put down to increased capital maintenance and servicing costs, reduction in power output with the consequent upsetting of operating schedules, reduced pay load and the difficulty of obtaining suitable fuel. The artificial disadvantages due to such vehicles being placed in higher tax and lower speed-limit categories are probably more potent considerations. It is stated that the vehicles operated by the Committee have covered a distance of more than 170,000 miles, but no information is adduced regarding these trials. Nor are any figures given of the results obtained in Continental practice, although several members of the Committee had already studied the use of producer gas vehicles on the Continent, and close watch was kept on developments taking place abroad.

The design, which the Committee states is not suggested as necessarily representing finality, appears to be suitable for vehicles up to 6 tons gross weight of 3–4 litres engine capacity. Grave difficulties in operation were found to follow relatively minor constructional defects, and failure to adhere strictly to the dimensions laid down has frequently led to trouble. The design as outlined appears to have the merit of simplicity from the point of view of manufacture and lends itself to mass production. It is suitable for use with low-volatile anthracite and certain low-temperature cokes, and may be mounted on the vehicle itself or on a trailer as thought best in each individual case. We are informed that full details regarding the plant and its working can be obtained from the Director, Fuel Research Station, London, S.E.10.

There are among the conclusions reached by the Committee several valuable items of information such as the availability of different classes of suitable fuel, effective methods of gas filtration and the classes of service for which gas producer vehicles can be most economically used.

EXPLOSIVE ACTIVITIES OF A JAPANESE VOLCANO

THE volcano Kusatu-Sirane suddenly became active with a remarkable explosion on November 27, 1937, and from that time until October 1938 it was studied in great detail by T. Minakami (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., 17, Part 3, September 1939, pp. 590–623). The volcano was very active during December 1937, and January and February 1938. It was more calm from April until August 1938, but became active again from the latter part of September. A rather violent explosion occurred on October 5, 1938, and after that date large quantities of gas were ejected, while ash was scattered near the *Y* crater. At the same time, volcanic pulsations and volcanic micro-earthquakes occurred and these were still continuing in February 1939.

So far as situation on the earth's surface is concerned, the active fissure differed from the fissure of previous activity of October 1932. The hypocentres of the micro-earthquakes were found to be at a depth of 1·7 km. According to geothermic measurements, the region of high temperature was restricted to the narrow zone along the active fissure. From observations of the water-level of the hot spring pond in the crater, it was concluded that the quantity of water that filtered through the fissure at the bottom of the pond amounted approximately to 750 tons a day. The gas ejected from the crater was mostly aqueous vapour, though on several days during May and October 1938 large quantities of evaporated sulphur were emitted with the steam. Boring showed that the floor of the *Y* crater consisted of alternate layers of precipitated sulphur, volcanic detritus and ash.

The presence of the sulphur gave the estimate of 444° C. for the temperature of the vapour, though often it was below this temperature. The quantity of seeping water would affect this, as would the supply of heat from the subterranean origin. Judging from the distribution of volcanic detritus, the pressure of gas at the time of the principal explosions under discussion was almost 150 atmospheres, which is slightly less than that of the explosion of October 1932 as calculated by T. Matuzawa.

H. Tsuya suggests that these explosions were phenomena near the earth's surface resembling those of a geyser.

SEVENTY YEARS AGO

Nature, vol. 1, March 24, 1870

The Transits of Venus in 1874 and 1882

"A Parliamentary paper issued at the close of last session gives some information on what is intended to be done in the matter of the great approaching astronomical events of 1874 and 1882. . . . For the proper observation of this event [the transit of 1874] the Astronomer Royal informs us that it will be necessary, after making allowance for all the aid that may be expected from foreign and colonial observatories, to organise expeditions to the following five stations :—(1) Oahu (Sandwich Islands), (2) Kerguelen's Island, (3) Rodriguez, (4) Auckland (New Zealand), (5) Alexandria. At the first three of these stations . . . it will be necessary to make preparatory observations for twelve months, in order to ascertain the absolute longitudes of these places, which are not exactly known. . . .

"But what I wish to call attention to at the present moment is the valuable opportunity thus afforded for still further augmenting the importance of this event to the progress of science generally, by converting these proposed astronomical expeditions into expeditions for general scientific observation. . . . The additional expense of attaching two or three qualified Natural History observers (or at any rate collectors) to these three expeditions could not be very great. The numerous American and Russian exploring expeditions are invariably accompanied by zoological and botanical collectors, nor is the money required to publish the results obtained by them grudged by the Governments of these countries. Even poverty-stricken Austria did not send the *Novara* round the world without a competent corps of naturalists. . . . Far from lagging behind, wealthy England ought to take the lead in such cases. . . .
P. L. S."

Conductivity of Copper

"Sir William Thomson [Lord Kelvin], having had his attention directed to the very great differences that exist in the conducting quality of copper wire professing to be of the 'highest conductivity', had a large number of specimens carefully tested and the following are some of the results obtained—the quality is indicated by the resistance of a metre length weighing one gramme. The best specimen was one supplied by M. Bréguet, Paris, of which the resistance was ·153 of an ohm per metre weighing one gramme. Specimens from English manufacturers varied as follows :—·165, ·169, ·171, ·178, ·206, ·213, ·221. Seven specimens labelled 'highest conductivity', stood as follows :—·156, ·182, ·201, ·205, ·223, and ·258. As it is to the interest of all scientific men that the copper wire used in electrical instruments shall be of the best quality, there should be general co-operation to discourage as much as possible the use of inferior copper. Variations in conductivity like those in the samples of copper mentioned above would produce instruments varying to the extent of 40 per cent."

Miss Garrett has been admitted as a member of the medical staff of the East London Hospital for Children, and was appointed one of the physicians on Wednesday last. This is the first hospital in Great Britain which has recognized in this manner the female medical movement.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Second Assistant Bacteriologist and Pathologist—The Clerk of the County Council, County Buildings, Stafford (March 28).

Teacher of General Engineering subjects, including Engineering Science, Drawing and Mathematics, etc.—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (March 29).

Temporary Engineering Assistant in the Waterworks Department of the Halifax Corporation—Mr. J. Noel Wood, Waterworks Engineer, Gibbet Hill, Halifax (March 30).

Lecturer in Veterinary Physiology and Biochemistry at the Veterinary College, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (April 2).

Graduate Lecturer to teach Mechanical Engineering subjects in the Plymouth and Devonport Technical College—The Education Office, Cobourg Street, Plymouth (April 6).

Lecturer in the Mining Department of the Doncaster Technical College—The Acting Chief Education Officer, Education Offices, Doncaster (April 10).

Professor of Zoology—The Registrar, University College of Wales, Aberystwyth (April 15).

Teacher of Engineering subjects—The Principal, Technical Institute, Ladywell, Dover.

Laboratory Superintendent of the Government of Nigeria Medical Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9173).

Demonstrator in Physics—The Dean, Guy's Hospital Medical School Office, Sherwood Park, Tunbridge Wells.

Technical Assistant (Male) to the Adviser in Economics to the West Midland Province—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 1 : On a Problem concerning Matrices with Variable Diagonal Elements. By Walter Ledermann. Pp. 17. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) 1*s*. 6*d*. [272

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 3 : The Normal Œstrous Cycle of the Ferret—The Correlation of the Vaginal Smear and the Histology of the Genital Tract, with Notes on the Distribution of Glycogen, the Incidence of Growth, and the Reaction to Intravitam Staining by Trypan Blue. By Prof. W. J. Hamilton and J. H. Gould. Pp. 87–106+3 plates. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) 4*s*. [272

Other Countries

New Zealand. Report of the Tenth Australian-New Zealand Cancer Conference held at Wellington, New Zealand, 15th to 17th February 1939. Pp. 44+A10+B14. (Wellington : Government Printer.) [262

Memorie del R. Istituto Lombardo di Scienze e Lettere. Vol. 24, Fasc. 1 : Contributi alla teoria delle connessioni, 2 : Connessioni di specie superiore, fondamenti analitici calcolo del vitali generalizzato. Memoria del Prof. Enea Bortolotti. Pp. 40. Vol. 24, Fasc. 2 : Contributo allo studio delle reti per comunicazioni elettriche. Memoria di Giovanni Cocci e Rinaldo Sartori. Pp. 41–124. Vol. 24, Fasc. 7 : Carta archaeologica delle stazioni enee emiliane a occidente del Reno. Memoria della Prof. Pia Laviosa Zambotti. Pp. 295–418. (Milano : Ulrico Hoepli.) [262

Carnegie Institution of Washington. Year Book No. 38, July 1, 1938, to June 30, 1939 ; with Administrative Reports through December 15, 1939. Pp. xxii+394. (Washington, D.C. : Carnegie Institution.) 1 dollar. [272

Report of the Aeronautical Research Committee, Tôkyô Imperial University. No. 184 : Über Radiator (1). Von Daizo Nukiyama, Jiro Mikura und Yuzo Akishino. Pp. 439–470. 50 sen. No. 185 : The Forces on a Plane Aerofoil in a Wind Tunnel of the Gottingen Type, with Special Reference to Approximate Formula for the Lift. By Susumu Tomokita and Hazimu Umemoto. Pp. 471–558. 1.10 yen. (Tôkyô : Kôgyô Tosho Kabushiki Kaisha.) [272

U.S. Department of Agriculture. Farmers' Bulletin No. 1102 : The Crow in its Relation to Agriculture. By E. R. Kalmbach. Revised edition. Pp. ii+22. (Washington, D.C. : Government Printing Office.) 5 cents. [272

Smithsonian Miscellaneous Collections. Vol. 99, No. 2 : Geologic Antiquity of the Lindenmeier Site in Colorado. By Kirk Bryan and Louis L. Ray. (Publication 3554.) Pp. iv+76+6 plates. (Washington, D.C. : Smithsonian Institution.) [272

Contributions from the Physical Laboratories of Harvard University for the Year 1938. Series 2, Vol. 5. Pp. vi+45 papers. (Cambridge, Mass. : Harvard University Press : London : Oxford University Press.) 21*s*. 6*d*. net. [272

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WAR-TIME FOOD POLICY

THE publication of "Feeding the People in War-Time" by Sir John Orr and Mr. David Lubbock has served to direct public attention to a subject of the utmost importance in our war effort, namely the need for a sound and consistent policy in regard to food.*

In Great Britain the public has always been interested in food questions. The British Press devoted as much space to reviews and commentaries on the final report of the League of Nations Committee on Nutrition as did all the rest of the world's newspapers. Now rationing has given every individual a personal interest in food supplies; certainly Mr. Morrison will not complain that the country is indifferent to the doings of the Ministry of Food.

Nevertheless, the peace-time structure of the British Government machine was singularly ill-adapted to the evolution of food policies. Food supplies were not within the control of any single Minister, nor were they the principal concern of any Department of State. The Ministry of Health had a food department mainly concerned to safeguard the public from adulteration or from the cumulative effects of small quantities of preservatives. The General Department of the Board of Trade was concerned with food but, at least in recent years, mainly from the angle of the administration of import quota schemes. The Department of Scientific and Industrial Research includes the development of scientific knowledge regarding food preservation among its activities. The Ministry of Agriculture, although mainly concerned with the production of food, had no responsibilities towards the British consumer. There was thus no Ministry which could consider the food problem, either to secure adequate levels of nutrition in peace or to prepare the nation for war. When the series of political crises gave warning of the imminence of war, a Food (Defence Plans) Department was established under the Board of Trade, and this body was the nucleus from which the present Ministry of Food has been developed.

Having regard to this prior history, it was not surprising that the Food (Defence Plans) Department should not have been able to make more adequate preparations for food supplies before the War broke out. It is true that the case for obtaining large stocks of wheat, sugar and other easily stored products was urged by Sir Arthur Salter in the House of Commons and by other authorities in the Press, but it is by no means easy for a hastily constituted department to overcome the resistance of the Government machine to new proposals. As a result, Great Britain entered the War without substantial stocks of cereals, sugar and feeding stuffs, although it is understood that large supplies of edible oils and oil-seeds were obtained.

In considering the food policy during war, it is as well to compare the position of Great Britain with that of Germany. Under peace conditions, Germany produced 80–85 per cent of her total food requirements, while the contribution of British agriculture to United Kingdom requirements amounted to between 30 and 33 per cent when measured on a calorie basis. Such information as is available suggests that the German authorities have realized the importance of the protective foods, and hence, although there has been a falling off in the general standard of living of the German people, milk and vegetables have been abundant and cheap. Although Great Britain is far more dependent upon imports than Germany, the former is far less susceptible to blockade. Even if enemy action becomes more serious than it has yet been, we shall be able to rely on large sea-borne supplies reaching at least our western ports. Nevertheless, it is of the utmost importance that British agriculture should be in a position to make a maximum contribution to our requirements. This is equally important from the point of view of shipping and as a relief to the financial drain which must inevitably occur when a country mobilizes all its resources for war and must obtain large supplies of armaments, munitions and raw materials from abroad.

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* "Feeding the People in War-Time". By Sir John Orr and David Lubbock. Pp. vii+88. (London : Macmillan and Co., Ltd., 1940.) 1*s.* 6*d.* net.
The main argument was published in an article by Sir John Orr in NATURE of March 9, p. 374.

These points have been brought out by Sir John Orr and Mr. Lubbock, but they have laid special emphasis upon another most important factor. For many months before the actual outbreak of war, indeed since the Munich Agreement, Germany has been conducting a 'war of nerves.' This war may well prove to be a contest in endurance between the English and French peoples on one hand, and the German people on the other. In such a contest it is clearly essential to pay special regard to the morale of the poorest sections of the population. Since the conclusion of the War of 1914–18, the newer knowledge of nutrition has thrown a flood of light upon the influence of food, not only on bodily health but also on the psychological reactions of the people. During 1914–18, Governments and General Staffs had little opportunity of knowing anything about such factors as the depressing effect of the lack of vitamin B_1 upon the combative spirit of armies, or the effect of shortages of the fat-soluble vitamins upon the physical, and hence upon the psychological, condition of nations. It should now be clearly realized that the staying power of a nation depends not only upon sufficient energy foods but also upon adequate supplies of minerals and vitamins.

Few will be prepared to dispute Sir John Orr's contention that, owing to the relatively high cost of the protective foods, about a third of the population of Great Britain suffer from some degree of malnutrition. This fact was established in "Food, Health and Income" and is confirmed by more recent dietary surveys. This being the case, it is not possible to disagree with Sir John's further contention that, in order to ensure the solidity of our national effort, not only must the national dietary be maintained on a satisfactory basis, but also steps must be taken actually to improve the diet of the poorest third of the population. To achieve this end Sir John Orr and Mr. Lubbock propose to adopt for food the more general proposals for an 'iron ration' suggested by Prof. J. R. Hicks and commended by Mr. J. M. Keynes. They propose that adequate supplies of a limited number of foodstuffs, selected on grounds of health and availability, should be sold at prices which would ensure that the poorest 10 per cent of the community, who may not have more than 4*s*. 6*d*. a head to spend upon food, should be enabled to purchase their full requirements of these foodstuffs at a price of not more than 3*s*. a head a week ; thus leaving 1*s*. 6*d*. a head to spend according to their tastes on other foods. It is tentatively suggested that the following foods should be selected : milk, potatoes, oatmeal, vegetables, bread, sugar and either butter or vitaminized margarine. It is maintained that, provided everyone could obtain full supplies of these seven foods, there would be no shortage of vitamins, and calcium requirements would be fully met, as well as those for other minerals. Of these foods four, namely milk, potatoes, oatmeal and vegetables, could be wholly produced in Great Britain. There is no suggestion that imports should be limited to wheat, sugar and fats, but rather that these three essentials, together with perhaps cheese and dried fruits, should be given priority on shipping space so that stocks could be built up in the country.

It is of vital importance that the policies of the British Government in regard to food and to agriculture should be so closely correlated as to be, in effect, complementary parts of the same policy. It can scarcely be claimed that this is the case to-day. Apart from the general ploughing-up policy, no clear indication of the part which British agriculture should play in the War has been given by responsible Ministers. On the other hand, the present guaranteed prices are likely to result in an enormous increase in the growing of oats, a substantial increase in wheat, and the maintenance or even increase in the fattening of cattle and sheep.

A simple method of ensuring the fullest possible production of milk, potatoes and vegetables is proposed. Farmers would be offered guaranteed markets at attractive prices for these products, not only for the War, but also for at least a three-year period after the War. This method would secure the aims sought, provided steps are simultaneously taken to discourage, by less attractive prices, an undue concentration upon cereal production or the feeding of imported concentrates to fatten cattle and sheep.

Vegetables, other than potatoes, constitute a special problem. Allotments will increase supplies, but not nearly to a sufficiently large extent. It is also necessary to stimulate farm production and to ensure that the vegetables are made available for retail sale at low prices. If, to give effect to this latter purpose, vegetable marketing is placed upon a more satisfactory basis, we shall have achieved in war something which has defeated us in peace.

It is not to be expected that the proposed food policy will obtain the support of all authorities, or that it will not encounter the opposition of special interests. The co-ordination of agricultural and import policies is, however, one of the most necessary of war measures, and the proposals under discussion do provide a logical basis for such a policy. It is also important to realize that the orientation of British agriculture towards milk and vegetable production has been advocated in the Astor-Rowntree report and by many other authorities. This war-time policy might, therefore, be expected to need little modification to adapt it to the conditions of peace.

PURE EXPERIMENT

Experimentelle Cytologie

Von Hans H. Pfeiffer. (New Series of Plant Science Books, Vol. 4.) Pp. xii+244. (Leiden: Chronica Botanica Co.; London: William Dawson and Sons, Ltd., 1940). 7 guilders; 18*s*.

EXPERIMENTAL cytology is both more and less than its name seems to say. To understand why, we have to look into its antecedents. It springs largely from the conflict of fifty years ago between vitalism and mechanism. It derives from the tradition born of this conflict, that the individual processes in the cell were physicochemical processes and that the cell as a whole, and even the organism as a whole, were to be completely understood by measuring and putting together these individual processes. Inspired by this doctrine, and inspired as well by the missionary zeal of Jacques Loeb, experiments were carried out which achieved their first purpose. They drove vitalism into the philosophical backwoods of biology, and in performing this apparently negative service they laid what should have been the foundations of a new science.

But unfortunately, while this was going on, a cleavage arose in experimental method. It was discovered that experiments of a rigorous kind could be carried out with the cell using biological as well as physical variables. Measurements could be made not only with variations in physical agents, such as temperature and *p*H, using physical properties, such as refractive index, surface tension, permeability, osmotic pressure, viscosity, specific heat and so on. They could also be made with variations in biological agents, such as genes, chromosomes, and nuclei, affecting biological properties measured in different ways and with different degrees of refinement. The methods used with these two kinds of approach became more divergent as the apparatus and the technique of each method became more elaborate. It is therefore important to see after this lapse of time whether the divergence depends on a necessary cleavage of purpose or whether it is perhaps artificial and spurious.

The "experimental" cytology which Dr. Pfeiffer describes is of the physical kind, and we have to admit that it still has the character of transplanted physics. After a lifetime of transplantation it does not appear to have developed an organic or integrated quality. It amounts to little more than a catalogue of measurements of the properties already referred to, a catalogue so disconnected that its several sections can be read in any order without loss of coherence. The method and the apparatus, it seems, are the connecting links, and not the results obtained by them. Where we might hope for analysis we find only description. The wheel has come full turn. Experiment having lost its purpose has lost its design. It has ceased to be an instrument of planned discovery and has become merely a repetitive occupation.

This decay in physical cytology was noticeable to some observers ten years ago. To-day in Dr. Pfeiffer's book it has become obvious by contrast with the biological method. The physical approach has been to the cytoplasm. It has yielded, as we may say, a series of anecdotes. The biological approach has been to the nucleus. It has yielded a connected story. The reason is perhaps a surprising one. The nucleus owes it predominance over the cytoplasm in growth and heredity not so much to a greater complexity of its components as to the permanence and precision of their structure. This precision has been shown by tests of X-ray mutation, ultra-violet spectroscopy and micro-chemistry combined with the general body of comparative and analytical cell and genetic studies (all of these left out of consideration by Dr. Pfeiffer). This in turn has meant that physical, chemical and biological methods of attack on the nucleus could be used, and used in combination, in a way that has not been possible in dealing with the undefinable cytoplasm; and in this attack, strangely enough, no one is any longer concerned to know whether the analytical operation is experimental or whatever the alternative may be.

Dr. Pfeiffer's book does a service in making the lesson of this contrast clear. The cell is a physicochemical mechanism, but it is a highly integrated mechanism. This integration can never be understood by means of experiments using variables of one kind alone, external or internal. We have to know it at each level of integration before we can fit the different levels together. Wherever we see a chance of such fitting together we must seize it.

> "*Dich im Unendlichen zu finden*
> *Musst unterscheiden und dann verbinden.*"

For this task, planning and co-ordination are necessary at every step. The co-ordination requires that we shall break down the segregation of plants from animals, of chemistry from genetics, and of experiments from less refined demonstrations. The planning requires that we shall not merely ask the right questions but ask them in the right order, without regard to departmental exclusiveness or (may we say it?) technical snobbery. C. D. DARLINGTON.

THE HISTORY OF GEOLOGY

(1) The Birth and Development of the Geological Sciences

By Dr. Frank Dawson Adams. Pp. v+506+14 plates. (London: Baillière, Tindall and Cox, 1939.) 22*s*. 6*d*.

(2) A Source Book in Geology

By Prof. Kirtley F. Mather and Dr. Shirley L. Mason. (Source Books in the History of the Sciences Series.) Pp. xxii+702. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

IT is now more than thirty years since a comprehensive treatise on the history of geology has appeared in the English language. For long Sir Archibald Geikie's admirable "Founders of Geology" and von Zittel's "History of Geology and Palæontology" have been the standard and, in fact, almost the only works exclusively devoted to this subject available for students. Since they were written, fresh studies in the history of geology have appeared from time to time, both in Europe and the United States. These have generally been of a more or less specialized character, and they have by no means exhausted the scope for further research. The appearance of two important new books on this subject is therefore a matter of considerable interest, particularly because both the original German edition of Zittel and the English translation by Mrs. Ogilvie-Gordon have long been out of print.

(1) The "Birth and Development of the Geological Sciences" was written during the author's retirement, after a lifetime of active geological work, and the story of how it came to be undertaken is worth telling. The fantastic theories put forward in past centuries to explain even the most commonplace of geological phenomena, such as the occurrence of minerals and fossils, aroused Dr. Adams's curiosity many years ago. Not content with reading about them at second-hand, he formed the habit of referring, when opportunity offered, to the original text of some of the more important early writers. Ultimately a growing interest in the subject led him to search out the works of other, less well-known authors. Thus, as time went on, he acquired an intimate knowledge of the byways as well as the highways in the early literature of natural science, in which are to be found the germs of present-day geological knowledge. In addition, in order to satisfy the necessity for repeated consultation of some of these early works, Dr. Adams, whenever possible, obtained copies for himself. In taking this course he followed, literally, the advice given as long ago as the fourteenth century by a very early booklover and collector, Richard de Bury, Bishop of Durham, which he quotes as follows, ". . . we secured the acquaintance of stationers and booksellers, not only within our own country, but of those spread over the realms of France, Germany and Italy, for no dearness of price ought to hinder a man from the buying of books, if he has the money that is demanded for them . . ." As a result, during the process of widening his knowledge of his subject, the author built up a specialized library, containing more than a thousand volumes in various languages, many of extreme rarity.

The belief, modestly expressed by Dr. Adams, that the knowledge derived from studies carried out during more than twenty years might prove of value to others unable to carry out such researches for themselves, fortunately induced him to prepare his notes for publication. The resulting book is, he explains, an attempt to trace the evolution of geological ideas from the first period of which we have any written record in Europe, that of the early Greeks, on through Classical Times, the Middle Ages and the Renaissance, down to about the year 1825, when geology as we know it to-day began its rapid development. The latter limit is not rigidly adhered to, since one or two chapters have been rounded off with a very brief outline of the later history of the particular subject dealt with, but no serious attempt has been made to discuss the period subsequent to this date.

The ground covered is indicated by the following list of chapter headings : bibliography and sources ; geological science in Classical Times ; the conception of the universe in the Middle Ages ; on the generation of stones ; medieval mineralogy ; the birth of modern mineralogy and its development from Agricola to Werner and Berzelius ; the birth of historical geology with the rise and fall of the Neptunian theory ; 'figured stones' and the birth of palæontology ; the origin of metals and their ores ; the origin of mountains ; earthquakes and the nature of the interior of the earth ; the origin of springs and rivers ; quaint stories and beliefs ; conclusion.

Dr. Adams makes the somewhat bold statement that few books likely to contain matter of real importance to his study remain unexamined by him, but after reference to the text no one is likely to dispute this claim, nor, indeed, the truth of the remark that his extensive reading proved the aptness of Bacon's aphorism, "Some books are to be tasted, others swallowed, and some few to be chewed and digested". Obviously some of the works consulted can have contained little that has a direct bearing on the subject, although, no doubt, they provided material to form the background essential for a proper appreciation of much that he has to say. Of this nature is the interesting chapter on the conception of the universe in the Middle Ages.

Dr. Adams deals more fully than previous authors with the ideas prevalent during the centuries preceding the emergence of geology as a separate branch of knowledge. It is impossible to refer in detail to the results of his researches into the early literature of science and natural history but I may mention one example. He discovered, and quotes at length, in translation, a hitherto almost unknown and exceedingly rare little book entitled "De Montium Origine". This was written by Valerius Faventies, and published at Venice in 1561, and, so far as is known, is the first treatise written in Europe dealing exclusively with the origin of mountains. Though its ideas are largely speculative, they are of interest, as Dr. Adams points out, in giving a picture of the manner in which a geological problem was approached in the later years of the sixteenth century. The treatise is cast in the form of a dialogue between two members of a party of friends, in a manner reminiscent of Boccaccio's "Decameron". Neither of the disputants gives any indication that he had ever climbed a mountain in his life, nor that he had any desire to do so. The days of geological field work had not yet dawned.

The formative years of geological science, the eighteenth century and the early years of the nineteenth century, are by no means neglected, and in dealing with this period Dr. Adams again quotes authors not referred to by either Zittel or Geikie, and other sources not available at the time these authors wrote, so that our knowledge of this period also is enlarged. The chapter on the birth of historical geology, for example, contains a particularly interesting and informative account of Werner and his doctrines.

Fortunately for his readers, Dr. Adams combines with a deep knowledge of his subject the ability to expound his store of knowledge in a charming and lucid style, and the result is a book that can scarcely fail to give pleasure to all who read it. Its attractiveness, too, is greatly enhanced by the inclusion of nearly one hundred illustrations, mostly reproductions from old scientific books. Yet the especial merit of this new history of geology is not merely that it is readable, or even that it adds so considerably to existing knowledge, but that the author has in every case gone back to original sources for his information. Thus, though his book does not supersede those of Zittel and Geikie, it must be regarded as the most authoritative work on the particular aspects of the subject with which it deals.

Unfortunately, a few small defects mar this otherwise excellent production. There are a number of typographical errors, some affecting the spelling of proper names, and others the dates of works to which reference is made. In addition, in one or two instances footnote references have been put in such a form as to cause difficulty in tracing the actual work to which it is intended to refer. Further, the value of the book as a work of reference would be correspondingly increased if the index were expanded.

Dr. Adams informs me that he intends to present his library to McGill University, where it will be housed in good company with the late Sir William Osler's collection of books on the history of medicine. It will then be known as the "Adams' Collection". A library of this type can only be built up after years of patient search, backed by adequate knowledge and sufficient means. It is welcome news, therefore, that Dr. Adams's unique collection is not to suffer dispersal, the fate of many important private libraries. Its value will be better appreciated after publication of the catalogue, on which the author is at present engaged.

(2) Opportunities for reading original texts of the type so largely represented in the Adams Collection are few. Many are written in Latin, and of these only a small number have been translated into any modern language; and, in any event, they are seldom accessible to the average reader. Those who may wish to consult works of this sort will be interested to learn that their needs have now been met, to some extent, by the publication of Mather and Mason's "Source Book in Geology".

This is the fourth in a series of "Source Books in the History of Science", published under the general editorship of Gregory D. Walcott and an advisory board of American men of science, assisted by special committees for each science. The enterprise has also received financial aid from the Carnegie Corporation of New York. The object of these "Source Books" is to make readily accessible the significant passages from the works of the most important contributors to the major sciences during the last three or four centuries, up to the end of the nineteenth century. Each therefore consists of a large number of quotations, carefully selected with as much finality of scholarship as possible. These are given in English translation when necessary, a decided advantage in the latest volume, in which nearly half the extracts were originally written in languages other than English.

In this volume the term 'geology' has been interpreted in its widest sense, and twenty-nine separate divisions of the science are represented. The compilers, in choosing their material, have attempted to strike a balance between the needs of readers interested in the science as a whole, and those of students concerned only with a particular branch of the subject. Preference has been given, where other considerations are nearly equal, to excerpts from sources least likely to be accessible to the majority of geologists.

The scope of the book may be judged from the fact that it includes three hundred and twenty-nine extracts from more than one hundred British, Continental and American authors, ranging in time from the fifteenth to the end of the nineteenth century. Contributions to geology made since 1900 have not been included, nor those by living authors. The excerpts are, in general, arranged in chronological order according to the date of birth of the authors, and a subject index is provided.

The task of compiling this book must have entailed an immense amount of literary research. Of its kind it is a pioneer work, and it may be said at once that the task has been well done. It is unlikely that complete agreement could have been obtained among the many collaborators as to the final selection of authors whose work should be quoted, and, in fact, this is hinted at in the preface. The compilers, however, accept responsibility for the final choice. In glancing through the pages of the book, one is struck more by the number of names included, many well known, others unfamiliar, than by the few questionable omissions. Yet a few names outstanding in the history of geology are missing. Among these may be noted that of Palissy the Potter, whose observations on fossils, made in the sixteenth century, it would have been interesting to read. The work of Lehmann and Füchsel, too, who made important stratigraphical observations in the eighteenth century, might well have been included. The original writings of these authors are to be found in very few libraries. In contrast, extracts have been given from the works of men of science not usually associated with geology, such as, for example, Robert Boyle. His observations on the conditions prevailing at the bottom of the sea, though of interest, are not original, and can scarcely be said to have had much influence on the development of geological thought. Cavendish, too, was not primarily a geologist, but, with more justification, an extract has been given from the account of his experiments to determine the density of the earth by means of the torsion balance. In reading this account, one is reminded of the interesting fact that this instrument of precision, now the tool of the geologist and prospector as well as the physicist, was actually invented by a geologist, John Michell, in the eighteenth century.

Though, perhaps, to be regarded primarily as a work of reference, this is a book into which any geologist can dip with the expectation of finding something to interest him. It forms a valuable supplement to the existing histories of geology, and the compilers are to be congratulated on the thorough and painstaking manner in which they have carried out their task.

The literature on the early history of geology has been greatly enriched by the publication of the two books reviewed above. Dr. Adams has, dealt fully with the long period ending in the early years of the nineteenth century, and Mather and Mason record the chief landmarks in the history of the science from the fifteenth right up to the end of the nineteenth century. The detailed story of the development of geology during the last hundred years, a period of great expansion in every branch of the subject, still awaits an author.

V. A. EYLES.

THE GOLGI APPARATUS

Form- und Stoffwechsel der Golgi-Körper
Von Gottwalt Christian Hirsch. (Protoplasma-Monographien, Band 18.) Pp. xi+394. (Berlin: Gebrüder Borntraeger, 1939.) 28 gold marks.

THE author of "Form- und Stoffwechsel der Golgi-Körper" attracted attention by his papers published in 1931, in which he claimed that the zymogen granules of the pancreas acinus cells originated not inside the Golgi apparatus, but drifted into that position from the base of the cell, where they originated in contact with the mitochondria.

Dr. Hirsch's claim was examined in my laboratory by E. S. Duthie in 1933, who agreed that very small granules were continually drifting across the cell into the region of the Golgi apparatus, where they swelled into zymogen. It cannot be said that Dr. Hirsch's work has been received everywhere with warmth among those cytologists who believed that practically all cell secretion granules originated inside the Golgi apparatus. Recently a strong attack on Hirsch and Duthie's work has been made in the *Quarterly Journal of Microscopical Science* by the competent Indian cytologist, Dr. Subramaniam, as a result of his investigation on the endostyle of *Branchiostoma indicum.* Nevertheless, Dr. Subramaniam fails to show what connexion the zymogen granules in the pancreas of the mouse have with the secretion of mucus in Branchiostoma, and as matters stand at present Dr. Hirsch's results must be accepted.

Following his interesting work on the pancreas, Dr. Hirsch has now written a book on the Golgi apparatus. He has read 2,000 papers on this subject, and appears to be convinced that there is such a thing as the Golgi apparatus. Furthermore, most of his ideas on the actual structure of the Golgi apparatus will be generally acceptable to British and American cytologists.

As is natural, the book deals more fully with the histological aspect of the subject, but Dr. Hirsch has interesting sections on spermatogenesis and oogenesis. One astonishing point about Dr. Hirch's book is the calmness with which he endeavours to harmonize the very different and apparently incompatible results of cytologists who have been sharply at variance in recent years. But Dr. Hirsch has tried to provide a view of this confused subject which might show the results of the workers of all countries in the best light, and he has certainly succeeded in this object very fully. Indeed, it could have been said in happier times that his book would have been certain to have inspired many of the younger zoologists and physiologists to undertake their life's work in this branch of cytology.

It is pleasant to read that Dr. Hirsch accepts the nature and homology of the plant osmiophilic platelets (Golgi bodies) discovered by the American cytologist, the late Robert Bowen. Dr. Hirsch dedicates his book to the curators of the University of Utrecht in gratitude for the opportunity given him of working there.

Dr. Hirsch's book, and the interesting researches of W. Jacobs, W. Buchmann, E. Ries, L. H. Bretschneider, J. W. Sluiter, O. Järvi and many other young Dutch cytologists, bear witness to the very valuable work now being carried out at Utrecht under his leadership.

J. BRONTË GATENBY.

CAPTAIN JAMES COOK, R.N., F.R.S.

The Life and Achievements of Captain James Cook, R.N., F.R.S.
Explorer, Navigator, Surveyor and Physician. By Surgeon Rear-Admiral John Reid Muir. Pp. vii+310+16 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1939.) 10*s.* 6*d.* net.

THE consideration of Cook as the 'physician' rather than the astronomer, surveyor and explorer well deserves this pleasant story. It is the central theme, which the author is well qualified to undertake, in the summaries of his three voyages, to the neglect of much consideration of their value to scientific knowledge; however, his bibliography is so short that more cannot be expected. Cook served his apprenticeship in small colliers trading along the English coasts. He chose similar ships for his voyages, and his knowledge of their capabilities was a large element in his success. His observations on the eclipse of the sun as seen in Newfoundland in 1766 caused him to be appointed by the Royal Society as its chief observer of the transit of Venus viewed afterwards from Tahiti in June 1769. A further object was the discovery of the great southern continents, a current myth at that period, the second expedition having this as its main objective; the third was primarily concerned with the North-West Passage. Cook everywhere found new lands, and nearly every chart of the Pacific is headed by his name. His running survey of New Zealand, which he completely circumnavigated, causes him to be regarded as the leader and greatest of that line of surveyors that has made the Navy famous. This had been especially brought out by the late hydrographer, Admiral Sir W. Wharton, in his studies of Cook, the error in the longitude of the observation station at Tahiti being only two minutes. That Cook attained international fame during his life is seen in that France, the United States, Spain and Russia extended to his third expedition a safe conduct in that war period.

Even the most careful research has yielded little knowledge of the character of Cook, while nothing is known of his domestic life. We judge that he was a reserved and lonely individual. That he was a personality with the necessary power of command is clear, in that the Admiralty gave him *carte blanche* in selecting his stores and crew. Among seamen his reputation was such that he had not to resort to the press-gang and to jailbirds, thus avoiding the danger of typhus then so rife. The result is seen in that his ship was not the prison as naval vessels were usually in those days, shore camps being established and leave frequent.

The great danger was scurvy, and long voyages often had to log a death-rate of 50 per cent or even more. The best authenticated case is Anson's voyage round the world in 1741, in which out of crews numbering 961 more than two-thirds died of scurvy, and on the homeward voyage only 71 were able to stand to their guns. Everywhere Cook's first care was water, which was never rationed; this an essential of a salt-meat diet. Every land was searched for scurvy grass, wild celery and other vegetable products, while fresh meat was purchased wherever possible. The strictest cleanliness was enjoined, Cook inspecting his crew twice weekly, while their quarters were ventilated and fumigated weekly, a proceeding recommended by Dr. Lind in 1753. It was forty years later that the Admiralty commenced the issue of lime juice, which has no antiscorbutic vitamins, a tragic error due to a confusion of names (lemon *v.* lime) that persisted for more than a hundred years. Cook largely relied on portable soup made of desiccated meat and bones, greens stored with salt which was termed "sour kraute", malt and beer concoctions, while fresh meat was everywhere sought. The results are well seen in Cook's voyages, as in all three the loss from scurvy was negligible, far less than that from Batavian dysentery and malaria while repairs were being carried out on the *Endeavour*.

TRIGONOMETRICAL TABLES WITH THE ARGUMENT IN TIME

Seven-Figure Trigonometrical Tables for Every Second of Time

Prepared by H.M. Nautical Almanac Office. (Published by order of the Lords Commissioners of the Admiralty.) Pp. 102. (London: H.M. Stationery Office, 1939.) 10*s.* 6*d.* net.

COMPUTERS are well aware of the difficulties experienced in dealing with right ascension, hour angle, etc., in astronomical work, when trigonometrical functions of these are required. It is necessary to convert them into degrees, minutes and seconds of arc before tables of trigonometrical functions can be used, and tables with the argument in time have been in demand for many years. The present volume supplies a need and is the first seven-figure table to be published which gives the four natural trigonometrical functions chiefly used in astronomy and related sciences, intervals of one second of time being used throughout.

The preparation of the tables was completed about twelve years ago under the direction of Dr. L. J. Comrie, formerly superintendent of H.M. Nautical Almanac Office, but approval for publication was not obtained until 1932, and the printing has been delayed for various reasons. Manuscript tables have, however, been in use in the N.A. Office for about seven years, and the table of tangents has been utilized in the computations of the right ascensions of the sun, moon and planets.

Seven decimals have been retained except in the cases of the cotangent. Here the number of decimals depends upon three desiderata: (*a*) linear interpolation; (*b*) the same number of significant figures as the tangent; (*c*) sufficient figures to enable inverse interpolation to give a mean accuracy of 0·001s., but as the first and third of these cannot both be satisfied everywhere, the scheme adopted is based mainly on (*b*). In some cases values of the cotangent to more decimals than are tabulated or to more than can be easily interpolated, are required, and to meet this need there is an auxiliary table containing the function $\tau = x^s \cot x^s$ to three decimals, for every second of time up to 30m. Eight significant figures can be obtained from this table by simple interpolation, and the cotangent or tangent can then be derived to seven significant figures by simple division. In both tables the greatest and least differences in any column are given at the head and foot of each column, no interlinear differences being given, and this arrangement enables the complete difference to be obtained from an inspection of the end figures.

The table is naturally intended for use with a computing machine, and computers are recommended to utilize the methods of direct and inverse interpolation which have been explained very fully in the "Nautical Almanac" for 1937, and reprinted in "Interpolation and Allied Tables" (H.M. Stationery Office, 1936). It should be added that the printing and reading of the proofs have been carried out under the direction of the present Superintendent of the Nautical Almanac Office.

M. D.

VIRUS RESEARCH

Methoden der Virusforschung
Von Prof. Dr. Henrique da Rocha-Lima, Dr. José Reis und Dr. Karl Silberschmidt. Pp. viii + 384. (Berlin und Wien: Urban und Schwarzenberg, 1939.)

FOR years the study of viruses was closely linked with bacteriology and mycology, descriptions of viruses occupying only minor parts of books devoted mainly to bacteria and fungi. This followed inevitably from the widely held belief that viruses differed essentially from other recognized pathogens only in size, and from the fact that they were investigated almost exclusively by a few enterprising bacteriologists and mycologists. Recently, however, the outlook has changed. A growing appreciation of the economic importance and scientific interest of viruses has attracted workers in other fields, and the need for separating viruses from other pathogens has become more and more obvious. One result of this has been the increased production of books dealing exclusively with viruses, of which that under review is the fifth to appear within two years.

In many ways this book differs from those previously published. One advantage it has is that the subject is treated as a whole. No gross distinctions are made between viruses attacking animals, plants and bacteria, all of which are dealt with under the same general headings, the book being kept to a reasonably small size by the omission of details of disease symptoms. A disadvantage is that the authors neither discuss controversial points nor criticize the work they describe. However, it is more than the description of techniques suggested by the title, for full details of the results obtained are also given, and, with one qualification, it is fairly described as a good, impersonal summary of experimental work on viruses. The gathering together of so much work published in a large number of apparently unrelated journals will be useful to most workers, but will probably be of greatest value to those who have not ready access to good library facilities.

The book is divided into three main sections, dealing respectively with viruses in diseased organisms, infection methods, and the properties of viruses *in vitro*, of which the last occupies about two thirds of the whole. The techniques described range from the construction of insect-proof glass-houses and the culturing of insect vectors, through such subjects as transmission, ultra-microscopy, ultra-filtration, centrifugation, cataphoresis, and serology to tissue culture and the culturing of viruses in developing eggs. Nevertheless, in spite of the variety of methods described, all those used in work on viruses are not included. This is, no doubt, a direct reflection of this book's greatest fault, which is that it is already out of date. Except for a short supplement containing references to a few papers published in 1938, the last papers referred to were published early in 1937. As a result, not only are the many advances made in the last three years excluded, but often undue prominence is given to methods that would no longer be used.

The illustrations are all line drawings and, although some of these may be an aid to the text, it is difficult to see what is gained from the inclusion of others, such as Figs. 1, 31, and 51. As the book is presumably meant as a laboratory handbook rather than one to be read, it is a pity it is not better bound, for it is unlikely that the flimsy paper cover and the loose stitching will withstand much handling.

F. C. BAWDEN.

OUTBREEDING AND SEPARATION OF THE SEXES

BY DR. K. MATHER,

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GAMETIC DIFFERENTIATION AND SEPARATION OF THE SEXES

THE process of sexual reproduction shows two remarkable features, namely, that in all but some of the lowest organisms there is gametic differentiation, the male and female gametes being morphologically and functionally distinct, and that there is, in some plants and most animals, separation of the sexes, the two kinds of gametes being produced by different unisexual zygotes.

The former phenomenon may very reasonably be interpreted as showing a division of labour. The female gamete is larger and contains, or is associated with, food stores, which may be utilized by the developing embryo, while the small male gamete is more motile and seeks out the less active egg prior to fertilization. Such a division of labour would appear to have a selective advantage and so would be favoured.

The reason for the separation of sexes is, on the other hand, not so easy to understand, more especially as it is far from being a universal property of sexual reproduction. A number of arguments have been put forward seeking to account for the known facts, and nearly all of them, in some way or other, relate unisexuality to differentiation of the gametes. Two fairly recent examples may be mentioned.

Waddington[1] discusses the phenomenon in the following words: "Probably, then, the original mechanism [of sex determination] was an alternative mode of reaction in the gamete itself. . . . Usually, however, the time at which the alternative is decided is pushed further back in the life cycle, probably on a safety first principle. Eventually, in the higher animals and plants, the sex determination of a gamete has been pushed back to the fertilization of the zygophase before". The sexes are separated supposedly in order to ensure that the gametes are differentiated.

In the higher plants, however, separation of the sexes is sporadic rather than regular, although the gametes and their associated tissues are as successfully differentiated, morphologically and functionally, as in animals. Furthermore, in certain plants and animals the sex of a unisexual individual may be controlled environmentally though its gametic differentiation is perfect and regular. Nor should gametic differentiation itself be regarded as a necessary part of sexual reproduction. Many Thallophyta have successful sexual reproduction with no differentiation, or, at least, no morphological differentiation of the gametes. Thus sexual separation can scarcely be considered to be merely a predetermination of gametic differentiation, though this aspect may, of course, play some part in the evolution of the diœcious state. Any hypothesis seeking to account for unisexuality in most animals must also provide a reason for the widespread hermaphroditism in plants.

Altenburg[2] has advanced a different view. He notes that hermaphroditism is related to sluggishness and sessility. Then by means of a highly ingenious argument he concludes that the monœcious and diœcious states are adapted to the minimization of the work involved in reproduction. Thus insect-pollinated plants are, he claims, all hermaphrodite, as they need expend little work in the production of male gametes, the insect ensuring that the pollen is transferred to a stigma; so they can distribute the reproductive load evenly between individuals only in this way. Wind-pollinated plants, on the other hand, expend relatively more energy in the production of pollen, much of which is lost in the air, and, the male and female loads being more nearly equal, they may as economically be diœcious as monœcious.

A similar argument is advanced for sessile and motile animals. Sessile forms have, like wind-pollinated plants, a large male load and so are indifferently hermaphrodite or unisexual. Motile animals may minimize the expenditure on sperm production by transference following coition, and so should be analogous to insect-pollinated plants. They are, however, unlike the plants in that they are not in general hermaphrodite. The reason given for this is that they overcome the difference in male and female reproductive loads by polygamy, sexual dimorphism and sexual differences in life-span.

There are a number of objections to this argument. In the first place, it is not clear why freely motile animals should be hermaphroditic less often than sluggish ones, when insect-pollinated plants are supposedly less often unisexual than anemophilous forms. In the second place, Altenburg goes too far in supposing that all insect-pollinated plants are hermaphrodite. *Silene Otites*, *Melandrium dioicum* and *Rubus Chamæmorus* are examples of diœcious entomophilous forms. Whether separation of the sexes is actually less common among insect-pollinated species is difficult to say as the available records are not always trustworthy, though some such correlation is suggested (cf. Lewis[3]). Finally, it is far from certain that wind-pollinated plants do in general produce more pollen per seed set than do insect-pollinated ones. Extreme examples of excessive pollen production by both kinds of plant could be cited, but it is doubtful whether statistics adequate to settle the question have been obtained. The same may be said of sperm production by animals. Until these objections have been successfully met, Altenburg's hypothesis cannot be accepted without crippling reservations, though it may be applicable to special cases.

SEXUAL REPRODUCTION AND SEPARATION OF THE SEXES

There is, however, another approach to the question which helps to make clear the reasons for sexual separation occurring in some cases and not in others.

First of all, it is necessary to dismiss the developmental-genetic idea that separation of the sexes is of necessity related to gametic differentiation. Such differentiation has its own function in relation to nutrition of the ensuing zygote and is present, often in an elaborate form, in both hermaphroditic and unisexual organisms. The morphological analogy between gametic and zygotic differentiation is only misleading.

There is, however, one inevitable consequence of the diœcious state which enables us to understand its occurrence. If the sexes are separate, fertilization must always involve gametes from different zygotes and, in the vast majority of cases, these zygotes must be genetically distinct. It is essentially a mechanism for the promotion of outbreeding.

Now the importance of sexual reproduction to living organisms is that by its aid a higher degree of hybridity and effective recombination may be achieved than would be possible with purely asexual propagation. An increase in the effective recombination allows of a more rapid response to the action of natural selection (Fisher[4], Muller[5], Darlington[6]). Thus outbreeding is an essential feature of sexual reproduction in that it necessarily leads to greater hybridity and so, ultimately, to a greater response to selection, than does inbreeding. It is not clear that the maximum advantage will always follow from maximum outbreeding. On the contrary, there is some evidence that species have an optimum degree of hybridity, which optimum may depend on the environment. This question is, however, too complex and uncertain to be given detailed consideration here. It is sufficient to note that outbreeding is an essential part of sexual reproduction.

It is, then, easy to see that unisexuality is of advantage by virtue of its ensuring some degree of outbreeding, and hence its occurrence is a simple adaptation for the more successful results of sexual reproduction.

There are, however, other mechanisms which will achieve the same purpose. Incompatibility is found in Angiosperms and the Fungi, and also most probably in the sea squirt *Ciona*. In the Fungi it apparently depends on the aversion of the haploid hyphæ, and in the Angiosperms on a rather complex relation of the pollen tube and stylar tissue. The genetical basis of incompatibility varies, though in Angiosperms it is usually of the type first described in *Nicotiana* by East. A related mechanism is that of illegitimacy found, for example, in *Primula* and *Lythrum*. It differs from incompatibility in that it is dependent on the genetical relations of the zygotes bearing ovule and pollen, and not on the genetical relations of male gamete and female zygote. These species, together with others, also show heterostyly, which presumably encourages crossing, though the efficacy of this mechanical method is open to doubt, as it is so frequently accompanied by an incompatibility or an illegitimacy mechanism. Protandry, protogyny, special floral arrangements and other devices could also be listed.

Now these various methods, though widespread, are rarely, if ever, found where the sexes are separated. They are alternatives to unisexuality. So our conclusion that the separation of sexes is simply a method of encouraging cross-breeding is strengthened, as such encouragement is the only effect common to all these mechanisms.

DISTRIBUTION OF OUTBREEDING MECHANISMS

If we are to regard unisexuality simply as one of a number of outbreeding mechanisms, it is necessary to account for the fact that it is frequently found in some groups, for example, the higher animals, but rare in others, for example, the higher plants, being often replaced in the latter case by one or other of its alternatives.

To understand this, let us compare the action of unisexuality and incompatibility. In a diœcious species an individual can cross with only a portion of the remaining population, namely, those of the other sex. Unless some way is available whereby each individual of at least one sex can seek out a member of the other sex with which to mate, so ensuring that its gametes are not wasted, there must be a large loss of reproductive energy due to maldistribution of the gametes. In most animals such wastage is, however, much reduced by the presence of such a discriminatory mechanism whereby the motile male seeks out the female and transfers sperm directly to the egg by coition. This cannot be done in higher plants.

The incompatibility mechanism is superior to unisexuality in that it leads to less gametic loss where indiscriminate mating prevails. In the *Nicotiana* type of behaviour, pollen only fails to function when it falls on to the stigma of a plant carrying the same allelomorph of the incompatibility gene as does the pollen itself. There may be a very large number of such allelomorphs. More than a hundred have been found in wild *Trifolium*. The actual gametic loss is inversely proportional to the number of allelomorphs and so may be very small. Hence the incompatibility mechanism has an advantage over unisexuality where no discriminatory mating is possible. On the other hand, no easy mechanism, such as mobility, can be developed to assist discrimination where so many genetic classes are involved. So unisexuality with discrimination may exceed incompatibility in efficiency, in the case of motile organisms, where the loss due to unisexuality can be reduced effectively to zero. Furthermore, there must be some mechanism for sorting out incompatible male gametes before they meet the egg, or otherwise loss of female gametes may result. This is done in the higher plants by the stylar tissues, but it would not be possible in most animals where fertilization takes place in a duct or in open water.

Hence it can be seen that there is a reasonable explanation for motile animals depending mainly on unisexuality while higher plants usually adopt incompatibility or an analogous system of gametic discrimination. In the former case, wastage from separation of the sexes is reduced by means of mate discrimination, whereas an incompatibility mechanism would be difficult to operate. In plants, mating discrimination is difficult but incompatibility easy to operate.

The above remarks about incompatibility apply equally well to the closely allied illegitimacy mechanism. The other outbreeding devices found in plants may also be considered in a similar way. Protandry, for example, discourages self-pollination in the same flower, where its risk of occurrence would be greatest, while ensuring that the rest of the population are capable of receiving the pollen after its release. It is not, however, a fool-proof device for securing outbreeding.

Thus unisexuality may be regarded as one of a number of devices which arise by reason of their encouragement of outbreeding. The one to be adopted in a particular species depends on its special features, though the most suitable mechanism may not always develop. Thus if the disadvantage of wastage following on separation of the sexes in a plant is less than the advantage gained by the encouragement of outbreeding, unisexuality might occur but would be liable to be weeded out as soon as environmental conditions reversed the magnitudes of these opposite effects. So the diœcious state is a transient feature of some Angiosperms. It is also clear that some species which are in a stable environment, to which they are highly adapted, may find recombination a disadvantage and so suppress outbreeding mechanisms or even substitute inbreeding adaptations as in *Pisum* and *Triticum*, where premature anthesis vitiates a highly developed crossing mechanism. This is easier to do where the sexes are not separated. 'Fertility' allelomorphs are, for example, known at the incompatibility loci of many plants which normally show this particular outbreeding mechanism. But to reconstitute hermaphrodites from highly developed unisexual species would seem to be more difficult. Hence inbreeding mechanisms are commoner, or at least more obvious, in plants than in animals. The marked sexual dimorphism of animals, developed as an ancillary arrangement for the more effective operation of the outbreeding mechanism, has prevented a return to hermaphroditism in any special cases where inbreeding would be desirable, except by the adoption of extreme devices, as in *Pediculus*.

Gynodiœcy should not be confused with unisexuality in this connexion. It resembles unisexuality in that a proportion of the individuals are female, but differs in that the remainder are hermaphrodite, not male. Clearly the females are at a disadvantage as compared with the hermaphrodites, since they produce but one kind of gamete. Hence gynodiœcy will only survive where the females enjoy some compensating advantage, which is most likely to depend on the outbred nature of their offspring. My colleague Dr. Lewis has shown[3] that the equilibrium proportion of females is directly dependent on the magnitude of this advantage ; so such gynodiœcious species have a ready means of adaptation to change in the hybridity optimum. The proportion of females and so of outbreeding increases with increasing advantage of hybridity and decreases as the advantage of hybridity decreases. Thus gynodiœcy, unlike unisexuality, is a highly adaptable outbreeding mechanism.

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[3] Lewis, D., "The Evolution of Sex in Flowering Plants" (in preparation).

[4] Fisher, R. A., "The Genetical Theory of Natural Selection" (Oxford Univ. Press, 1930).

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A NATIONAL ATLAS OF BRITAIN

By PROF. E. G. R. TAYLOR,
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WITHIN a few days of the appearance in NATURE of an article upon the proposed National Atlas[1], an afternoon meeting of the Royal Geographical Society devoted to a discussion of the project was opened by the present writer as chairman of the National Atlas Committee. A verbatim report of the proceedings appears in the current (February) number of the *Geographical Journal,* but since the discussion has already borne practical fruit, and since further arguments for pressing forward with the Atlas have been provided by public events, it appears that a useful purpose will be served by examining the points upon which agreement has been reached.

Prof. Kenneth Mason, chairman of the meeting, recalled that the urgent need for a National Atlas was first realized when the Society was asked to give evidence before the Royal Commission on the Geographical Location of Industry and of the Industrial Population. A portfolio of maps was laid before the Commission, including many that were then drawn for the first time, as, for example, the actual distribution of the industrial (as opposed to the general) population, the pattern of unemployment distribution, and maps showing the relative accessibility by rail of the principal towns of England and Wales in terms of time. Accessibility was a point stressed also by a road map on which was indicated the degree of likelihood of interruption of traffic by snow. This particular map, based though it was on the specialized knowledge of Mr. L. C. W. Bonacina and Mr. Gordon Manley, was rather sceptically received, yet the warnings that it conveyed and the silent advice that it offered have been abundantly justified during the present winter. Indeed, it is not too much to say that had this series of maps been consulted, the selection of centres for the location of reserve stocks of food and fuel, and the choice of boundaries for supply regions, could have been made far more efficiently than has seemingly been the case. The excuse so often made by the responsible authorities that not shortage of supplies but delays and difficulties of distribution are responsible for deprivation and distress is one that demands probing.

It is noteworthy, however, that in their recently published report, the members of the Royal Commission put on record their appreciation of the usefulness of the maps placed before them, and their intention of publishing some of them in a later volume. Should the recommendations of the Commissioners be implemented, then the strength of the arguments for a National Atlas must prove irresistible, for it would provide an obviously useful, even indispensable, adjunct to "Collection and co-ordination of information relating to location of industry, now in the possession of the various government departments", to "Research; and collection of information as to the various natural resources—land, agriculture, amenities, etc.—that may be affected by industrial location", to name but two of the tasks with which the proposed new Central Planning Authority would be charged[2]. Moreover, with the National Atlas lying open at the appropriate page, chapter and verse could be given for the "Advice to government, local authorities and industrialists as to problems of location' which the Central Planning Authority would be empowered to offer[2].

It is indeed the case, as the general discussions at the British Association and at the Royal Geographical Society have shown, that, in principle, the plea for a National Atlas finds general acceptance. Nevertheless, an actual Atlas might well fail to achieve usefulness on three or four counts, as, for example, if the information it contained was not entirely reliable or up to date, if the style of the maps was too academic or otherwise unsuited to the general public, if the price of the Atlas put it beyond the reach of all but well-to-do individuals and public bodies.

On all these points the latest discussion has provided information and advice of positive value. In the first instance it is clear that despite the generously offered co-operation of scientists, the Atlas would fail of its object if access could not be secured to official statistics before their publication in Blue-book form. This is essential, not only to avoid a double time-lag, but also because the methods employed in grouping statistics for tabulation often render them unsuitable for plotting on a map. The obvious corollary is that the Atlas must have official status, since such facilities could not be granted to a commercial firm or to private persons.

In respect of the style of the maps, there need be little apprehension, since the long experience and exceptional technical skill of the Royal Geographical Society's drawing-office is generously placed at the Committee's disposal for experimental work. Nevertheless the discussion brought out an important possibility which had perhaps been overlooked. It was pointed out that the Atlas would undoubtedly be drawn upon frequently for newspaper maps, maps to illustrate articles and lectures, lantern-slides and the like, so that it would be very desirable to bear in mind what would be the appearance of a photostat copy or half-tone block made from any Atlas map: significant detail printed, for example, in blue would, of course, be lost. It is here perhaps not irrelevant to note that the secretary of P E P (Political and Economic Planning) in a written reply to a criticism by the writer of the weak and faulty map illustrations in that body's recent memoir on Location of Industry, took up the point of view that economists did not profess competence in cartography and would welcome a reliable source from which illustrative maps could be obtained at will.

The question of how to make a National Atlas accessible at relatively small cost to all those requiring to use it has not been lost sight of, and there has been a general consensus of opinion that the Atlas should be published serially as and when individual maps or groups of maps are completed. The Director General of the Ordnance Survey, speaking from his unrivalled knowledge of the distribution to the public of national maps and plans, expressed the view that the sale of single sheets should be made possible, thus allowing many people to participate cheaply in the benefits the Atlas could afford to their particular interests. As another speaker remarked, motorists, salesmen, publicity agents, and many others might require the maps dealing, for example, with transport, amenities, or industrial location, while they would have no interest in maps of fisheries, geology, and the like. On the production side, the sale of single maps might introduce difficulties, but there is no doubt of the importance and the feasibility of the second suggestion coming from Major-General Macleod, namely, that the Atlas should be 'tied' to the series of national plans and surveys (the ordnance maps) by the adoption of the metric grid recommended by the Davidson Committee. By the use of a suitable projection, and by substituting the rectangular lines of the grid for the curved and converging lines of the ordinary graticule, a basic source of difficulty, confusion and error to which the non-geographical map user is prone is at once removed. The position of any point can be exactly determined, and since it is proposed to place an identical grid on all the maps in the National Atlas irrespective of scale, a means of accurate enlargement or reduction is immediately at hand when it is required to make comparisons between maps on different scales. The original plan to make the one to a million scale the basic scale of the Atlas has been seriously challenged on two grounds: that it would make the Atlas as a whole too heavy and bulky to handle, besides the individual sheet being too large for the ordinary desk or table, and that it would require the use of sheets of paper of unusual size which would greatly increase the prime cost. Experiment has proved that a scale of 1 : 1,250,000 for the largest map, that of England and Wales, obviates both these disadvantages, disadvantages which would so repel the public which it is desired to reach, that they must be eliminated at all costs.

It is pleasant to be able to record that funds are in sight for the printing and distribution of numbers of blank base maps on which individual scientists will be invited to plot their contributions. When a sufficient number of such manuscript maps is in hand, it is confidently expected that they will provide in themselves convincing arguments for that official approval and for that public or private financial support which, once secured, will quickly bring a National Atlas into being.

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[1] NATURE, 144, 929 (1939).

[2] Report of the Royal Commission on the Distribution of the Industrial Population, 1940, p. 203.

THERMODYNAMICS AND THE STRUCTURE OF MATTER*

By A. R. UBBELOHDE,
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THE equilibrium positions of atoms and molecules in condensed phases are the result of an interplay between the forces of repulsion and attraction, and the thermal motions in the substance. This explains why thermodynamic considerations can make important contributions to theories of the structure of matter. Advances in the knowledge of various crystal structures have, on the other hand, led to considerable progress in thermodynamics.

One of the properties of crystals illustrating this statement is the 'lattice energy', which can be defined as the heat of sublimation at absolute zero. The intermolecular forces[1] that lead to phenomena such as deviations from the perfect gas equation, capillary and adsorption processes, and the broadening of spectral lines, also lead to the arrangement of all molecules in regular crystal lattices at sufficiently low temperatures. In different crystal lattices, repulsive forces nearly always arise from a common cause, namely, the interpenetration of electron clouds around individual atoms. For discussing energetics, crystals are therefore best classified according to the predominant force of attraction. The highest lattice energies are observed when the predominant force is due to covalency (for example, diamond, 135 kcal./mole), or electrovalency (for example, common salt, 181 kcal./mole). A special case of electrovalency arises for metal lattices, in which the negative ions are electrons, the small mass of which leads to special quantum-mechanical forces (for example, sodium, 26 kcal./mole). When the predominant attraction is due to permanent dipoles, the lattice energy is considerably smaller (for example, ammonia, 7 kcal./mole). If hydrogen atoms are present in the crystal, the close approach of the hydrogen atom, forming part of one dipole, to another polar atom, may lead to 'hydrogen bonds'[2]. Finally, the predominant attractive forces may be due to polarization. In rare but interesting crystal lattices such as chlorine hydrate, $Cl_2.8H_2O$, and krypton hydrate, $Kr.6H_2O$, the non-polar chlorine and krypton are polarized chiefly by the permanent dipoles of water. Polarization due to zero point motion of the electrons around each atom leads to the much commoner 'dispersion forces', such as predominate in the crystal lattices of inert gases and non-polar hydrocarbons.

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* Based on a course of lectures delivered at the Royal Institution on November 1, 8, 15 and 22.

In principle, the experimental measurement of lattice energies would involve a determination of the heat of sublimation at any one temperature, followed by extrapolation to absolute zero, using the specific heats of crystal and gas. Lattice energies are, however, seldom known with sufficient accuracy at present to give full significance to this correction. This is partly due to the fact that the vapour pressure of most crystals is too low to permit a direct calorimetric measurement of the heat of sublimation. Numerous indirect determinations depend on two thermodynamic rules:

(1) The Clausius Clapeyron equation, which states that the heat, $\triangle H$, absorbed in any change of phase can be calculated from the volume change, $\triangle V$, and the temperature coefficient of the equilibrium pressure, P, according to the formula $\triangle H = T \triangle V(dP/dT)$;

(2) Hess's Law, which states that the total heat required to proceed from any state A to a state B of the system does not depend on the intermediate route.

The first of these rules is commonly applied in evaluating heats of sublimation from vapour pressure curves. Manometric measurements of the vapour pressure are only possible for a few solids, such as carbon dioxide, but for solids with low vapour pressures the effusion method[3] has been used. A lattice energy of great importance is that of solid carbon, which has been tentatively evaluated from vapour pressure measurements on carbon arcs[4]. The Clausius Clapeyron equation is also used in calculating the lattice energy of polymorphs stable at high pressures[5].

An important example of the use of Hess's Law is presented by ionic lattices, for it is difficult to make direct measurements on changes of the type

$$\underset{\text{solid}}{[\text{NaCl}]} \rightarrow \underset{\text{gas}}{(\text{Na}^+)} + \underset{\text{gas}}{(\text{Cl}^-)} + 181 \text{ kcal.}$$

In this example, the heat of sublimation is calculated by summing the successive steps:

$$\underset{\text{solid}}{[\text{NaCl}]} \xrightarrow{+99\text{ kcal.}} \underset{\text{solid}}{[\text{Na}]} + \tfrac{1}{2}\underset{\text{gas}}{(\text{Cl}_2)} \xrightarrow{+53\text{ kcal.}} \underset{\text{gas}}{(\text{Na})} +$$

$$\underset{\text{gas}}{(\text{Cl})} \xrightarrow{+29\text{ kcal.}} \underset{\text{gas}}{(\text{Na}^+)} + \underset{\text{gas}}{(\text{Cl}^-)},$$

for which the heat changes are obtained by calorimetry,. vapour pressure determinations, or spectroscopic measurements[6]. An obvious weakness is that errors in the various steps may be cumulative.

Theoretical calculations of lattice energies aim at correlating crystal structures with heats of sublimation, and other properties of the crystal, and have met with considerable success in suitable cases[7].

As the temperature of a crystal lattice rises above 0° K., it acquires various forms of thermal energy. The contribution due to lattice vibrations is best considered separately, before discussing the contribution due to other 'modes of motion'. Among the phenomena which give fairly direct information about the lattice vibrations in various crystal structures are the specific heat, the temperature variation of the intensity of X-ray reflection from various crystal faces, and the thermal expansion.

In the region of temperatures where the law of Dulong and Petit applies, the specific heat is independent of crystal structure. At lower temperatures, the specific heat falls off, and Einstein was the first to calculate the vibrational energy E of crystals in terms of a single frequency ν, characteristic of crystal structure, obtaining the well-known expression, for a crystal of N atoms,

$$E = N\,[h\nu/(e^{h\nu/kT} - 1)].$$

A consideration of even simple models shows, however, that the thermal motions of atoms in a lattice must be interdependent, or 'coupled'. More complete theories of lattice vibrations must take into account the existence of a whole spectrum of frequencies. In this spectrum there must exist frequencies the wave-length of which is much greater than the lattice spacing, and a maximum frequency the wave-length of which is twice the lattice spacing. Owing to the very large number of frequencies (some 18×10^{23} per gram atom) distributed in the vibrational spectrum, some method of approximation must be devised in calculating their contribution to the vibrational energy. A successful approximation was proposed by Debye, who replaced the spectrum of a real crystal by the more easily calculated spectrum of a continuum. The only reference to a discrete lattice structure was introduced by breaking off the spectrum of the continuum at a maximum frequency ν_M. Debye's expression for the vibrational energy of a crystal

$$E = 9RT\left(\frac{T}{\theta}\right)^3 \int_0^{\theta/T} \frac{x^3dx}{(e^x-1)}, \text{ where } \theta = \frac{h\nu_M}{k},$$

bears about the same relation to experiment as van der Waals' expression does to actual deviations from the perfect gas equation.

The spectrum of real crystals differs from that of Debye's continuum both in showing a wave velocity decreasing with rise in frequency, in place of the constant value assumed for a continuum, and in showing a preferential distribution of frequencies around certain values, in place of the smooth distribution for a continuum. Formulæ have been proposed for the vibrational energy of crystals, involving more than one θ parameter, but since empirical equations automatically gain in flexibility by increasing the number of adjustable parameters, it is not yet possible to assess their theoretical importance[8] in detail.

One disadvantage of specific heat measurements, as a clue to the thermal vibrations of atoms in crystals, is the very fact that a whole series of measurements can be summed in terms of only one parameter—the characteristic temperature θ—which can be related to crystal structure. In principle, much more direct information about the 'mode of motion' of the atoms is obtainable from measurements of the decreased intensity of X-ray reflections with rise in temperature. The intensity of reflection I_T at temperature T from crystal planes with lattice spacing d is given by the expression

$$I_T = I_0 e^{-M},$$

where $M = 4\pi^2 \bar{u}^2/d^2$, I_0 is the intensity at 0° K., and $\bar{u}^2$ is the mean square displacement of the atoms normal to the crystal plane, due to thermal motion. The effect can be demonstrated by a simple model, and has been used in studying thermal vibrations in ionic and metal lattices[9]. It also indicates the zero point motion of atoms in a lattice at 0° K.

The heat motions of the atoms lead not only to a decrease in the intensity of X-ray reflections, but in addition to thermal expansion of the lattice. This is due to the atoms vibrating in a field the law of force of which is non-harmonic. A simple expression relating the coefficient of thermal expansion α with the specific heat C_v, the volume V_0 and the compressibility X_0, is

$$(\alpha V_0)/(C_v X_0) = -d \log \nu_M / d \log V.$$

For most crystal lattices, the maximum frequency ν_M decreases as the volume V increases, and in this case the lattice *expands* with rise in temperature. A correlation of thermal expansion with crystal structure is as yet limited to isolated cases[10].

In crystals containing hydrogen, a special method of studying lattice vibrations involves the replacement of hydrogen by deuterium. This leads to expansions of the lattice in certain cases, and the interpretation is simplified owing to the localization of the change at specific bonds in the crystal[11].

A limited number of crystals have other means of acquiring thermal energy, in addition to vibrations of the lattice. As a rule, these are detected by accurate specific heat determinations. The main features of accurate calorimetry can be summarized under the headings of accurate control of the supply of heat (usually by electrical means), accurate measurement of the rise in temperature of the substance (usually with a resistance thermometer or thermocouple) and accurate control of the heat exchange with the surroundings, obtained by suspending the calorimeter in a high vacuum, and surrounding it with an 'adiabatic' mantle maintained approximately at the temperature of the calorimeter.

When other means of acquiring thermal energy are present in the crystal, they show up on the specific heat curve by a 'hump', that is, a sharp rise in specific heat above the normal vibrational value, followed by an even steeper fall. Other properties of the crystals, such as the magnetic susceptibility, the dielectric constant, and the refractive index may vary rapidly over the same region of temperatures as the specific heat anomaly, and can be used as additional means of studying the phenomena, or for demonstration in a lecture.

Typical examples are the transformation in nickel (ferromagnetic-paramagnetic), the change from ordered to disordered alloy in β-brass, and the (presumed) rotation of methane and other hydrocarbons in their crystal lattices above a certain temperature, though many other cases are known. The almost catastrophic intake of thermal energy in all these cases is due to a co-operative effect between neighbouring molecules, which may be illustrated by reference to the rotation of methane. The crystal forces restraining rotation are due to the interaction of neighbouring molecules, which maintain preferred orientations in the lattice at sufficiently low temperatures. The thermal energy required by isolated molecules to overcome these restraining forces, and to rotate freely, may be quite large, but once they are rotating their restraint on their neighbours is lessened. Further molecules will thus have to acquire less thermal energy in order to rotate freely; the transition to complete rotation has analogies with an autocatalytic process[12]. This explanation is substantiated by experiments on the specific heat anomaly of methane with increasing amounts of krypton in solid solution[13]. The krypton atoms lessen the mutual restraint of neighbouring methane molecules, acting as lubricants, with the result that the abnormal intake of heat becomes less and less catastrophic.

The problems and results of calorimetry are of importance both for theories of crystal structure, and also in the calculation of equilibrium constants. The entropy of a solid can be written

$$S = S_0 + \int C_p \, dT/T,$$

and for a perfect gas, $S = S_0' + \int C_p \, dT/T - R \log_e P$, where S_0, S_0' are the (arbitrary) entropy constants. In order to calculate equilibrium constants solely from heats of reaction and specific heats, that is, from calorimetric measurements, it is necessary to evaluate these entropy constants. The solution proposed by the Nernst heat theorem can be stated in such a way that S_0 for solids is zero, so that S_0' for gases can be determined from the vapour pressure curve. Cases are known, however, where the assumption $S_0 = 0$ for the crystal does not agree with experiment. The simplest example arises in crystals of molecules such as NO, CO, N_2O, in which the molecules appear to have random orientations below the lowest temperature of measurement[14]. As a result, the experimental evaluation of the integral $S = \int C_p dT/T$ misses out a specific heat 'anomaly', merely because of the experimental difficulty in making measurements at still lower temperatures. The constant S_0 appears to be greater than zero, in compensation.

Interpretation of these and of other departures from the Nernst heat theorem is greatly facilitated by a knowledge of the crystal structures, and presents one more illustration of the interdependence of thermodynamics and theories of the structure of matter.

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OBITUARIES

Sir Charles Hagbert Wright

SIR CHARLES HAGBERT WRIGHT, who died on March 7 last at seventy-seven years of age, was a notable librarian, a man of letters and a characteristic London figure. He was a man of strong personality tempered with kindness. To describe him as a born librarian may be thought to do him less than justice. He possessed that logic of mind, energy of character, organizing ability and power of handling men which are as necessary to the librarian of a great library as to the man of business. To these qualities he added a wide knowledge of languages and a love of literature.

Sir Charles's association with the London Library began some forty-six years ago, when the library was much smaller than it is to-day. His wide circle of friends enabled him to acquire valuable donations of books and to collect necessary funds for new buildings in 1896 and for subsequent extensions. He realized the essential part a large library has to play in the advancement of learning and was successful in inculcating in his staff the feeling that they too were concerned in this work.

From such a library as the London Library long arms stretch out, embracing the globe and gathering continually material for the enrichment of its stores of information. In his extensive travels Sir Charles made and improved such contacts, without which no great library can function effectually. Nor does a sometimes insufficiently appreciative public always realize that the services rendered by such a library depend on the smooth running of a train of mechanism comprising many wheels. I well remember with what interest Sir Charles explained to me, many years ago, the details of the hidden silent machinery in the London Library, much of which he had himself designed.

Russian subjects claimed the first place in Sir Charles's literary interests. Yet his book "Nicholas

Fabri de Peiresc", published in 1926, came within the field of science. As he said, "Here we have the phenomenon of an antiquarian who was equally engrossed in medicine and surgery, in astronomy and scientific research". The combination of naturalist and antiquary in his uncle, Edward P. Wright, may have given him a lead in that direction. Through his brother, Sir Almroth Wright, the celebrated pathologist, Sir Charles had many contacts with the scientific world, and he always endeavoured that the committee of the London Library should include scientific men. Alfred Russel Wallace and Sir Archibald Geikie were among the well-known men of science who served in this capacity in his time.

Although the London Library is essentially a library of general scope, its extent implies that it should contain valuable collections of scientific works. Sir Charles endeavoured especially to secure whatever he thought would be of value to future historians of science, and the Library's extensive representation in the history of science and of medicine is of special value to scientific men. S. C. BRADFORD.

Prof. S. Lees

PROF. SAMUEL LEES held the Chance chair of mechanical engineering at the University of Birmingham from October 1, 1931, until his death on January 27 last. The son of Alderman S. H. Lees, of Salford, he was born in that town on August 26, 1885. He received his early engineering training at Ferranti, Ltd., of Hollinwood and Charles Churchill and Co., Ltd. (afterwards The Churchill Machine Tool Co. Ltd.), of Broadheath, Manchester. Whilst a student of the Manchester School of Technology he gained a Whitworth Exhibition in 1905 and a Whitworth Scholarship in 1906. At about this time he won a prize of £200, open to technical students generally of Great Britain, offered by Messrs. George Newnes, Ltd., in connexion with their periodical *Technics*.

After proceeding to Cambridge he took his B.A. in 1909, and later his M.A. He was awarded the Rayleigh and John Winbolt Prizes in 1911, became Hutchinson Student, and was elected in 1912 a fellow of St. John's College. In 1913 he was appointed reader in applied thermodynamics in the Faculty of Technology of the University of Manchester.

From 1915 until 1918 Lees was with the Navy, first as engineer lieutenant and afterwards engineer lieutenant commander. Most of his war service was spent on research work at Portsmouth Dockyard and concluded with a short spell at Farnborough. After the War he returned to Manchester. From 1919 until 1929 he was Hopkinson lecturer in thermodynamics at the University of Cambridge, and for a number of years director of engineering studies at St. John's College. He left Cambridge to become consultant mechanical engineer to Silica Gel, Ltd., and spent some time in Baltimore, U.S.A., on problems concerning the application of silica-gel to industrial uses.

After two years in industry, Lees returned to academic life to take the chair at Birmingham. Here he reorganized the research work of the Department of Mechanical Engineering and was engaged in the investigation of several problems having a bearing upon air-conditioning and upon internal combustion engine theory and practice. These included the air-cooling of metal surfaces, heat transmission through metals and loose aggregates, the study of delay-period phenomena in compression ignition engines, catalytic and other methods of improving combustion in engines of this type, exhaust noise in internal combustion engines, electrical methods of indicating high-speed engines and the flow of gases through orifices and nozzles with the view of correlating experimental work with dimensional theory. Some of these researches were in an incomplete but advanced state at the time of his death.

Prof. Lees was a man of unassuming disposition and incapable of self-advertisement. A first-class teacher, a profound thinker on his subjects, helpful to the point of self-sacrifice to all with whom he was associated, his early death at the age of fifty-four years is a severe blow to the University of Birmingham and to his colleagues, his staff and his students, especially foreign students, who had an affectionate regard for him. He leaves a widow and two sons.

WE regret to announce the following deaths:

Prof. Alfred Bielschowsky, at Hanover, New Hampshire, U.S.A., for many years professor of ophthalmology at Marsburg and Breslau, and a leading authority on motor disturbances of the eye and the physiology and pathology of space sense, aged sixty-seven years.

Prof. Edouard Branly, the pioneer in radio communication, on March 25, aged ninety-five years.

Mr. E. T. Cottingham, the well-known maker of scientific time-recorders, on March 20, aged seventy years.

Sir Patrick Laidlaw, F.R.S., pathologist to the Medical Research Council, deputy director of the National Institute for Medical Research, on March 20, aged fifty-eight years.

Mr. W. H. Lovegrove, formerly conservator of forests, Kashmir, on January 25, aged seventy-two years.

Prof. E. Mapother, professor of clinical psychiatry in the University of London, formerly medical superintendent of Maudsley Hospital, on March 20, aged fifty-eight years.

Prof. D. S. Margoliouth, F.B.A., Laudian professor of Arabic in the University of Oxford during 1889–1937, on March 22, aged eighty-one years.

Prof. W. S. Miller, emeritus professor of anatomy in the University of Wisconsin, on December 26, aged eighty-one years.

Prof. Michael Siedlecki, professor of zoology in the University of Cracow.

Dr. Werner Spolteholz, emeritus professor of anatomy in the University of Leipzig, on January 12, aged seventy-nine years.

NATURE

SUPPLEMENT

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SHORT REVIEWS

ANTHROPOLOGY OF ARCHAEOLOGY

Aboriginal Woman, Sacred and Profane

By Dr. Phyllis M. Kaberry. Pp. xxxii+294+8 plates. (London: George Routledge & Sons, Ltd., 1939.) 15*s*. net.

DR. KABERRY'S observations among the aborigines of north-west Australia, of which certain of the results are given in this volume, mark a new departure in the study of the primitive peoples of that continent. While it is no new thing for women to enter the field of anthropological investigation with the specific object of illuminating the sphere of the woman among backward people—that is a matter of the anthropological history of more than a generation—and Australian records include the names of more than one notable woman observer, Dr. Kaberry has approached the problem of the tribal woman from what in Australia is a new point of view. Hitherto, both in form and content, tribal life and organization have been assumed tacitly to be mainly the province of the male members of the group, with the female as an appendage or adjunct of the male, performing, it is true, certain functions essential to the continuance of the group and to the life of the individual, but otherwise of little significance. Here in Dr. Kaberry's detailed record of the results of observations carried out among various tribes in 1934 and 1935–36 is set out the evidence of how far the female members can be regarded as socially individuals, and how far the functions attributable to them pass beyond the 'profane' in tribal life and enter into the 'sacred' province, in which the male has hitherto monopolized the centre of the picture in anthropological investigation.

If it be said that the results of Dr. Kaberry's investigations enlarge considerably the conception of woman's status and function in the Australian tribe, that need be no matter for surprise, at least for many who have regarded previous records from this aspect with some reserve. She has, however, gone considerably beyond most of her predecessors by transcending the form of tribal institutions and extending her inquiry to 'cases'—in other words, by finding out how far these institutions work, how far they are elastic, so as to admit alternative modes of behaviour, and how far they are flouted by the conduct of individuals. As a result, the aboriginal woman emerges not merely as an anthropological specimen, but also as a human being and an individual—essentially of the feminine order.

Herbert Spencer Betrayed

With some account of the repudiation of the "Descriptive Sociology" by his Trustees. By Alfred W. Tillett. Pp. x+68. (London: P. S. King & Son, Ltd., 1939.) 4*s*. 6*d*. net.

MR. TILLETT vigorously attacks the trustees of Herbert Spencer's will on the grounds: (1) that while the terms of the will required his estate to be applied to completing the publication of "Descriptive Sociology", which was uncompleted on Spencer's death, they acted *ultra vires* in publishing Dr. Rumney's "Herbert Spencer, Sociologist", in which Spencer as philosopher and man is vilified; and (2) that they determined the Trust and distributed the balance of the fund among the residuary legatees before the work, for which the trust was created, had been completed.

Mr. Tillett, though advised to the contrary, still hopes that it will be possible to obtain a judicial pronouncement on the position he has taken up; and it is therefore undesirable to express any opinion here, even if the case were not one involving difficulties of interpretation, legal and other. There is no doubt that in such matters open accusation is better than underground insinuation. It may be pointed out, however, that the trustees had exercised every care in becoming discharged of their trust. Not only had the Court already varied the terms of the will to meet changed conditions, but also the opinion of the Attorney General was sought before the trustees took final action. With the legal position of the trustees thus clarified, in view of recent development in sociological studies, further expenditure in this direction seemed to be largely waste.

BIOLOGY

Keys to the Phyla of Organisms, including Keys to the Orders of the Plant Kingdom

By Fred A. Barkley. Pp. iv + 40. (Missoula, Montana: Associated Student's Store, 1939.) 75 cents.

IN this pamphlet of thirty-nine pages, Dr. Barkley gives a series of dichotomous keys referring chiefly to the orders of the various 'plant' phyla. The keys have been drawn up to meet the needs of the author's class in plant morphology and have been so constructed as to reflect in large part the views of outstanding authors regarding certain groups. They are intended to give also a more or less comparative treatment of the ordinal category under the various phyla.

Students who have a general knowledge of systematic botany and zoology will find it useful first to get a bird's-eye view of the classification employed by referring to the outline given on pp. 26–27. In this outline the sequence of phyla, classes and orders follows that of the keys, and only in broad outline, therefore, can the classification be regarded as an expression of relationships. Organisms as a whole are divided into four kingdoms: Monera, Protista, Phyta and Zooea. Cohn's old group 'Schizophyta' is retained as a division of the Monera and serves to include Cyanophyceæ, Spirochætæ and Schizomycetes. An unusually wide interpretation is given to the Protista, since this kingdom is made to include not only Protozoa and Parazoa but also all the organisms commonly classed as Algæ and Fungi. Bryophytes head the list of the phyla placed in the kingdom Phyta and are followed in turn by Pteridophytes and Spermatophytes, the last phylum of which—the Anthophyta—includes the large number of orders into which Dicotyledons and Monocotyledons are divided. Apart from an occasional change of name and a different sequence, the orders of flowering plants are the same as those proposed by Hutchinson in "The Families of Flowering Plants". In the keys to the orders a great deal of detailed observation is compressed, much of which will not prove easy reading to the elementary student, but the inclusion of a useful glossary (pp. 29–38) will help to get over the difficulty. J. R. M.

Bibliography of the Larvæ of Decapod Crustacea

By Dr. Robert Gurney. (Ray Society, Vol. 125, for the Year 1937.) Pp. vii + 123. (London: Bernard Quaritch, Ltd., 1939.) 12*s*. 6*d*.

THE preparation of bibliographies is often a thankless task, although few would deny their importance. The present example covers the literature of the larvæ of Decapod Crustacea (excluding the Euphausiacea) up to May 1939. It comprises three sections—an alphabetical list of authors, a classified catalogue in which the literature is arranged zoologically, and an index to genera. Some eight hundred titles are recorded.

We have tested the work here and there both as regards completeness and accuracy, and have little criticism to offer. Every bibliographer knows that completeness is unattainable and even accuracy is curiously difficult to achieve. Nevertheless, we have noted only the following errors and omissions: the paper by Audouin and M. Edwards, 1828, on the nervous system of Phyllosoma, Dalyell's "Powers of the Creator", vol. 1, 1851, containing observations on Decapod larvæ, Leach's earlier article on Megalopa of 1814, and Leeuwenhoek's letters of 1686 and 1700 on the development of Crangon are omitted. Crawford and Smidt's paper on Panulirus should be dated 1922 and for "Larvæ, p. 9" read "Larva, p. 309"; Milne Edwards is not a hyphenated name and should be catalogued under Edwards; Hornell's papers on Squilla and Scyllarus were reprinted in a volume of "Microscopical Studies" in 1901; the reference to Linnæus should be to the twelfth edition, Holmiæ, 1767; and Slabber's figure of the zoea larva should be dated 1769.

Dr. Gurney is to be congratulated on the completion of a valuable piece of bibliographical research and the Ray Society for having undertaken its publication. F. J. C.

Basic Methods for Experiments on Eggs of Marine Animals

By Ernest Everett Just. Pp. x + 89. (London: The Technical Press, Ltd., 1939.) 6*s*. net.

THE methods used in experimental investigations of the eggs and spermatozoa of marine invertebrates depend very strongly on the adherence to some general rules. Some of these are set out in this little volume, which should be useful for beginners in the field of experimental embryology, and for the specialist whose work demands individual extension of methods. Whilst the techniques described apply to the gametes of American marine species, they are sufficiently general to be applicable also to the gametes of the same species, and to those of closely related species, in European waters. Dr. Just has developed his methods over a period of twenty-five years, so that the issue of this book was to be expected as a necessary supplement to his recently issued "Biology of the Cell Surface". In no wise can it be claimed to be a catalogue of all methods in use, but, nevertheless, the methods described, and especially those relating to preparations of fixed tissues, should be of value to cytologists.

Notes on the Genus Dioscorea in the Belgian Congo

By I. H. Burkill. (Extrait du *Bulletin du Jardin botanique de l'Etat*, Vol. 15.) Pp. 48. (Bruxelles: Jardin botanique de l'Etat, 1939.)

THIS important study is by one of the authors of the revision of the Eastern Dioscoreas. It will prove invaluable in compiling any general account of the genus in Africa. Twenty-three species are recorded with several varieties for some of them; two of the species are here described for the first time. These species of the Congo are attributed to six sections of which four twist to the left. A definition of each section is given, and a key to the species is provided for each plurispecific section. A full history and synonymy of every species will be found, together with a comprehensive statement of the known collectors and its distribution within and without the Belgian Congo. Many interesting notes are furnished on the depth below ground-level at which the tubers are seated, on their edibility and method of preparation for food; poisonous properties; bulbil production and self-protective measures. Of peculiar interest and value are the discussions on the origin, evolution and "ennoblement" (improvement and refinement by selective cultivation) of the most-prized yams. It is indicated that some of the problems involved can only be solved in the field and that "the paper is intended to direct all who are able to study the Congo Dioscoreas alive to points worthy of their particular attention".

A debt of gratitude is due to Mr. Burkill for collating much valuable information from many sources and adding the results of his own patient and extensive research, both in the herbarium and in the field, which has cleared up several obscurities.

CHEMISTRY

Perkin and Kipping's Organic Chemistry

By Prof. F. Stanley Kipping and Dr. F. Barry Kipping. Part 3. Revised edition. Pp. viii+615–1030. (London and Edinburgh: W. & R. Chambers, Ltd., 1939.) 9*s*.

OF late years there has been a marked dearth of works dealing with advanced organic chemistry in a manner suitable for students reading for an honours degree in chemistry. Part 3 of "Perkin and Kipping's Organic Chemistry" can be recommended with confidence to such students and also to research workers. It is a handy volume comprising some four hundred pages and yet not too bulky for an ordinary pocket. Its twenty-three chapters afford concise and up-to-date treatments of a surprisingly large number of subjects of current importance in organic chemistry, including physical properties, isomerism (four chapters) and isomeric change, carbohydrates (two chapters), terpenes and related groups (three chapters), carotenoids, anthocyanins, metallic ketyls, aromatic substitution, etc. The chapter on heterocyclic compounds (12 pp.) is limited to azoles, diazines and vitamin B. In this new edition the configurational formulæ of the sugars (which gave rise to difficulties as expressed in the first edition) have been revised, and two new chapters have been added: one of these deals with the theory of resonance (12 pp.) and the other with sterols, bile acids and other steroids (21 pp.). The text and formulæ are neatly printed, and there is a good index.

A Text-Book of Quantitative Inorganic Analysis

Theory and Practice. By Dr. Arthur I. Vogel. Pp. xix+856. (London, New York and Toronto: Longmans, Green & Co., Ltd., 1939.) 18*s*.

AS would be expected of a teacher with wide experience of students of all grades, Dr. Vogel has produced in this book a notable contribution to chemical literature and a valuable guide to those engaged in chemical study.

The book is divided into six chapters dealing respectively with the theoretical basis of quantitative analysis, the experimental technique required, volumetric, gravimetric, colorimetric and gas analyses. In each of these chapters, the reader will discover a wealth of detail not only of the more classical methods of analysis but also of the most up-to-date modifications and discoveries. Most of the new methods have been tried out in the author's own laboratory. In addition, there is a comprehensive appendix containing chemical data which will be of great value to practising analytical chemists, whilst teachers of chemistry will find much interest in the suggested schemes of study for various examinations.

Dr. Vogel's book can be confidently recommended to students of all grades as a sound, up-to-date and accurate treatise on methods of analysis, a study of which will be amply sufficient for all examinations up to the honours degree. The book should also be on the bookshelf of all industrial analytical chemists, who will find it a useful reference book in modern methods of analysis.

Physikalische Methoden der analytischen Chemie

Herausgegeben von W. Bottger. Teil 3: Chromatographie, Verdampfungsanalyse, Spektroskopie, Konduktometrie, Photoelektrometrie, Polarographie, Potentiometrie. Pp. xx+836. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 65 gold marks.

THIS book is more than merely a description of the application of a number of physical methods to analytical chemistry. This is due to the fact that the editors have taken a very broad view of what constitutes analytical chemistry. The consequence is that much pure physical chemistry finds its way into the volume. There is, of course, emphasis on experimental technique.

The main subjects treated are chromatographic analysis, analysis by fractional evaporation, spectroscopic analysis, photometric methods and analysis by conductometric, polarographic and potentiometric methods. It is absolutely impossible in a short review even to give a list of the contents, for they are so varied. The aim of each contributor is not only to describe methods but also to give enough practical details so that the reader may conduct the experiments with success. Moreover, each section of the book is copiously provided with references to recent literature. For example, the section on potentiometric methods includes at least one thousand references.

There is much in this book to interest physical chemists as well as those who wish to find the most useful analytical technique for any given problem. The index and table of contents make the search among such a mass of material an easy business. The volume is well printed and bound but is rather expensive.

H. W. M.

ENGINEERING

Electricity Meters and Meter Testing

By G. W. Stubbings. (Monographs on Electrical Engineering, Vol. 6.) Pp. x+216. (London: Chapman & Hall, Ltd., 1939.) 12*s*. 6*d*. net.

IT is only of recent years that the question of the metering of electric supply has been seriously tackled. The question itself is a most difficult one, and the introduction of tariffs and the theory of statistics, and attempting an impossible accuracy, have certainly not made it easier. The easiest way is to put a sub-standard wattmeter in series with the consumer's meter for a day or a fortnight and then read them both simultaneously. If they both read the same then everyone is satisfied. But the meter reader who has had his own sub-standard meter tested at a standardizing institution and knows the curve of error of his own meter sometimes wonders whether it is correct or not. The present limits for consumers' meters as described in the Electricity Supply (Meters) Act of 1936 are 2½ per cent plus or 3½ per cent minus. That is, the permissible error when the meter is going fast is less than when it is going slow. The test of the meter at no load should always be taken, and if it is rotating then it is a long and costly business to find out what is wrong.

From what we have said it will be seen that it is no easy matter to meter an electric supply. Even the expert who is thoroughly familiar with the apparatus used in an electrical laboratory, or even in a meter-testing house, will find that there are numerous problems inseparable from the everyday work of the meter-tester that are not yet satisfactorily solved. For example, there are errors due to bearing friction, fluid friction, frequency, phase, self-braking, temperature, varying load, voltage variation, wave distortion, official limits, tariffs, etc. It is no easy task to keep in good working order hundreds of thousands of little meters, and the task of the superintendent of a meter-testing department is no sinecure.

The author of this book has a thorough knowledge of the difficulties in the way in Great Britain and knows well the difficulties in many cases of treating equitably suppliers and consumers. He includes an appendix giving the titles of many recent books on the subject and also of technical papers. The reader will find that it is no easy matter to become a meter expert.

Elements of Practical Aerodynamics

By Prof. Bradley Jones. Second edition. Pp. viii+436. (New York: John Wiley and Sons, Inc.; London: Chapman & Hall, Ltd., 1939.) 18*s*. 6*d*. net.

THIS is the second edition of an American book, the first of which was reviewed in NATURE of July 31, 1937. It is an exceedingly lucid and simply written students' text-book, that should prove useful to engineers or physicists commencing the study of aeronautics. A feature of the book is the large number of worked examples in the text, and further exercises at the end of each chapter. These are carefully graded and form an admirable addition to the book; one which might well be added to most English books on this subject of the same standard.

The subject-matter has been brought up to date, and most of the more modern developments mentioned in a general way. Some of this later work is superficial, but not unduly so remembering that it is an elementary and necessarily restricted work. Among these are discussions on tapered monoplane wings, methods of working out low drag contours, performance calculations including approximate rapid prediction methods, problems of control and stability from the practical but not the mathematical point of view, and details of the more modern aerofoils (those more popular in the United States). A chapter on "Auxiliary Lift Devices"—about three pages—is disappointing, and makes no attempt to explain the many variations of the allied problems of speed range and control that arise from the use of these. Worked examples, as in some of the other chapters, would have been particularly valuable here.

As in the first edition, the book ends with chapters on such subjects as materials, meteorology, instruments, etc. These are accurate so far as they go; but are so short as to be of little use. They are illogical in a book with this title, and it seems a pity that the author did not confine himself to aerodynamics, and give fuller discussions upon the aspects of this in the relevant chapters.

FORESTRY

Principles of Forest Entomology

By Prof. Samuel Alexander Graham. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xvi+410. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 24*s*.

WE welcome the appearance, after a decade, of a second edition of this well-known handbook. Considerable advances have been made in that period as regards our knowledge of the principles of forest entomology. The European pine sawfly, for example, has become prominent as a forest pest in that short period. Certain chapters of the book have been almost wholly rewritten: others have been revised, and the bibliography has been brought up to date.

Elementary Forest Mensuration

By M. R. K. Jerram; with a Chapter on The Measurement of Forests, by R. Bourne. Pp. x+124. (London: Thomas Murby & Co., 1939.) 8*s*. 6*d*. net.

IN this little book, Mr. M. R. K. Jerram states that the word 'elementary' has been prefixed to the title as the work is intended chiefly for the professional forester rather than research specialist, and he has been guided in his method of treatment of the subject by this factor. For the greater number of professional foresters, either in being or still in the student stage, forest mensuration is a practical part of their work—the higher branches of the subject are required by the research worker alone.

Still, the author gives an account of a few of the less well-known methods in use by research workers. Otherwise in his treatment of the subject Mr. Jerram deviates but slightly from the ordinary lines, which are not capable of much variation. An interesting chapter on "The Measurement of Forests" is contributed by Mr. R. Bourne, late lecturer in forestry at Oxford University. The book may be recommended as a useful text-book.

GEOLOGY

Geology of London and South-East England

By G. M. Davies. Pp. viii + 198 + 4 plates. (London: Thomas Murby & Co., 1939). 7*s.* 6*d.* net.

IN a recent broadcast on "Science in Wartime", Sir Albert Seward, then president of the British Association, commended to his listeners the interest and satisfaction that are to be gained from dipping into the history of past ages on the earth, and he chose as one of his examples the study of the London Clay. For those who, for cultural or utilitarian ends, would like to follow up this suggestion in the still rather heavily populated area of south-eastern England (and are prepared to take the risk of being arrested as spies in the course of their field studies), the book under notice appears at the opportune moment.

Instead of adopting the usual historical method of treatment—from ancient to modern—the author reverses the process in the belief that people will find it easier to work back from the known present to the unknown past. His treatment therefore opens with "made ground" and recent deposits, and passes on to the records of early man, ancient river deposits, the relics of the Ice Age, and so to the Tertiary rocks of the London and Hampshire Basins, the Chalk, and finally the pre-Chalk formations that are included within the area from the Fens to Oxford.

Other interesting subjects treated in a simple way are the Palæozoic floor under the east of England, the water-supply, the building-stones of London, and the development of scenery. Abundant photographs, text-figures of characteristic fossils, geological sections, sketch-maps and judiciously selected references to relevant publications (for those who wish to pursue the subject further) enhance the usefulness of the book.

Die Entwicklung der Kontinente und ihrer Lebewelt

Ein Beitrag zur vergleichenden Erdgeschichte. Von Prof. Dr. Theodor Arldt. Zweite, vollständig neubearbeitete und erweiterte Auflage. Band 1. Pp. xviii + 449–1005. (Berlin: Gebrüder Borntraeger, 1938.) 44 gold marks.

THE first edition of Prof. Arldt's great work appeared in 1907. Since that time, great advances have been made in palæogeography, biogeography and related sciences. Further, a complete new theory of the origin of continents and oceans has burst upon the geological world. This second edition is therefore a greatly expanded one, the first volume of it alone amounting to a thousand pages. The first part of this volume, issued in 1936, was noticed in NATURE of May 29, 1937, pp. 902–3. In it the question of the permanence of the earth's major features was raised, and the answer is not yet forthcoming even in the thousand pages of the present volume. It seems likely, however, that land-connexions between continental masses will be approved, but for the final answer we must await the second volume, which will contain the geological and cosmological findings.

In these thousand pages, then, we have a very detailed examination of the distribution of present and past life. So far as this colossal mass of information can be handled, it is summarized in a series of tables and charts. The last thirty pages of the volume deal with a few general topics, such as the geological distribution, the regions and the origin of life. By the ordinary geologist, who appreciates at least the quantity of the evidence produced by Arldt, the geological verdict will be awaited with interest.

MATHEMATICS AND ASTRONOMY

Modern Machine Calculation with the Facit Calculating Machine Model Lx

By H. Sabielny. Translated and revised by Dr. L. J. Comrie and Dr. H. O. Hartley. Pp. 74. (London: The Scientific Computing Service, Ltd., 1939.) 5*s.*

APART from the many excellent brochures issued by the leading makers of modern calculating machines, there is very little scientific literature on the subject. This is somewhat strange in view of the increasing use made of these machines in present-day business houses, coupled with the fact that probably the first adding machine was exhibited so early as 1884. The present manual will therefore be welcomed by all who wish to know something authentic about modern machine calculation. Mr. Sabielny's original text was published by Aktiebolaget Facit, Atvidaberg, Sweden, by whom the Scientific Computing Service, Ltd., under the direction of Dr. L. J. Comrie, was requested to prepare an edition suitable for use in English-speaking countries. Whilst the text deals particularly with the Facit Model Lx, much of it is applicable generally to other machines of similar type.

There are four parts dealing respectively with fundamental principles, examples of practical calculations, British currency and tables. The translators have followed the original text on the whole, although certain sections have had to be either cut out or modified. They have also incorporated some important new matter. Part 2, for example, on British currency, weights and measures, is new, whilst the very practical sections on 'short-cutting' in multiplication and division have been extended and a new method given for carrying out the rule of three with one operation without any embarrassment from complements.

The manual has been excellently prepared by the translators and should provide a very practical and scientific guide to the use of the modern calculating machine.

F. G. W. B.

(1) Annuaire pour l'an 1940

Publié par le Bureau des Longitudes. Avec des Notices scientifiques. Pp. viii+550+A16+B26+C54. (Paris: Gauthier-Villars, 1940.) 25 francs.

(2) The Observer's Handbook for 1940

(Thirty-second Year of Publication.) Pp. 80. (Toronto: Royal Astronomical Society of Canada, 1939.)

(1) AMONGST the various handbooks published each year mention may be made of the "Annuaire", published by the French Bureau of Longitudes, and "The Observer's Handbook" of the Royal Astronomical Society of Canada. The former has a long history, being first published in 1795, when it contained about eighty pages. The present comprehensive volume contains 550 pages besides an appendix. Its contents are grouped under the following headings: (1) Calendar for 1940 including astronomical data, tide predictions, etc.; (2) Earth—geodesy, meteorology, terrestrial magnetism, time determination; (3) Astronomy—star charts, minor planets, comets, stellar spectra, etc.; (4) Units of measurement; (5) Physical and chemical data. Two special articles are appended: "L'Espace Interstellaire", by M. Chas. Fabry (being the George Darwin Lecture of the Royal Astronomical Society for 1938), and "Le Bureau Internationale de l'Heure", by M. A. Lambert.

(2) "The Observer's Handbook" is purely an astronomical handbook intended more especially for the use of the non-professional. Besides providing a journal of astronomical events from day to day (datum, 75th meridian civil time), there are several useful tables. One of these gives the principal facts regarding 259 stars brighter than apparent magnitude 3·51. Another gives the position and type of the star clusters and nebulæ contained in Messier's catalogue compiled in 1781. A rough chart directs attention to the remarkable grouping of bright planets which occurred on February 28 (see also NATURE, January 27, p. 146). The transit of Mercury across the sun's disk on November 11–12 receives notice as it will be partly visible in Canada.

Structure of Algebras

By Prof. A. Adrian Albert. (American Mathematical Society, Colloquium Publications, Vol. 24.) Pp. xi+210. (New York: American Mathematical Society, 1939.) 4 dollars.

NOT only the contents, but even the title of this book may puzzle many good mathematicians of the older school. Algebra seemed to be a stereotyped subject which started with substitution, addition, subtraction, multiplication and division, had a great deal about equations, progressions, the binomial, exponential and logarithmic theorems, and then, after some chapters on miscellaneous topics, concluded with determinants and the theory of equations. There were a few pages headed the "Fundamental Laws of Algebra", which were generally felt to be an unnecessary statement of the obvious. At one time invariants came into fashion, and were spoken of as the "Modern Higher Algebra".

Now recently books have appeared having scarcely anything in common with older books except their titles. In Prof. Albert's "Modern Higher Algebra" (Cambridge University Press, 1938) the subjects dealt with are groups, rings, integral domains, fields and matrices. The subject of matrices, so important in quantum mechanics and factor analysis, is here taken as the starting point for the discussion of abstract entities satisfying the same laws as certain matrices. These entities are known as linear associative algebras. In the book under review a more advanced treatment of these algebras is given, including recent advances due to R. Brauer, H. Hasse, E. Noether, and the author himself.

MEDICAL SCIENCES

Bergey's Manual of Determinative Bacteriology

A Key for the Identification of Organisms of the Class Schizomycetes. By David H. Bergey, Robert S. Breed, E. G. D. Murray and A. Parker Hitchens. Fifth edition. Pp. xi+1032. (London: Baillière, Tindall & Cox, 1939.) 45*s*.

IN the sixteen years that have elapsed since the first publication of Bergey's "Manual" the work has undergone considerable change and amplification; many of the mistakes that detracted from the earlier editions have been rectified and the present edition, under its capable board of editors, shows a marked advance on its predecessors.

The assistance of experts has been made use of in the revision of certain groups—particularly in the realm of serology—and for the first time attention is directed to the serological grouping and typing of the hæmolytic streptococci and to the work of the Salmonella Sub-committee of the Nomenclature Committee of the International Association of Microbiologists on the taxonomy and classification of the genus *Salmonella*. In the latter connexion be it observed, however, that the organism of typhoid fever is still placed in the genus *Eberthella* instead of in the genus *Salmonella*, where by virtue of its serological characters it most certainly belongs, and that notwithstanding the serological identity of *Salmonella pullorum* and *Salmonella gallinarum* the latter is taken out of the genus *Salmonella* and placed in the genus *Shigella*, along with the dysentery bacteria. Furthermore, no mention is made of the significant serological relationship of the organism of tularæmia with the members of the genus *Brucella* and it is relegated to the genus *Pasteurella* on purely negative characters. The curious statement is made, moreover, that this widespread disease is only known in North America.

Strange omissions are still noticeable: one searches in vain for description of the organisms of pleuropneumonia and contagious agalactia and the other members of the group—this in spite of a considerable and growing literature on the subject. No doubt these and other questions will be considered at some future date and necessary action taken by the recently appointed Judicial Commission of the Nomenclature Committee of the I.A.M., of which the editor-in-chief of the "Manual" is one of the joint-secretaries.

William B. Wherry, Bacteriologist

By Martin Fischer. Pp. x+293. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall & Cox, 1938.) 27*s*.

THIS is in its way a quite unique biography of a bacteriologist, W. Buchanan Wherry (1875–1936), professor of bacteriology and hygiene in the Cincinnati College of Medicine, by an author, Prof. Martin H. Fischer, who was his subject's colleague and lifelong friend and has already earned for himself distinction in biographical literature. Though Wherry's services to bacteriology can scarcely be said to have been of an outstanding nature—perhaps his most important contributions were his recognition, practically simultaneously with McCoy, of bubonic plague among the ground squirrels of California and his isolation for the first time of *B. tularense* from a human case of tularæmia (Wherry and Lamb, 1914)—he had acquired in the course of his career as a bacteriologist in Manila, California and Mexico a very varied experience of tropical diseases and their methods of study.

Wherry must undoubtedly have had a great genius for friendship, and Fischer's tribute to his friend's life-work, based as it is on the numerous letters that passed between them since college days, and written in the very glowing terms employed by some American biographers of scientific men both living and dead, is sure to exert a powerful popular appeal. Perhaps the most interesting portions of the book are those that recount the life-story of Wherry's father, a missionary in India of strictest orthodoxy, and of his mother, sisters and brother. Letters that passed between the parents and the son—for they were all carefully preserved—throw a penetrating light on the daily doings of an Indian missionary and the financial struggles that seemed always to be pressing. For these revelations alone the book deserves a wide audience. It is beautifully produced—it represents in fact the last word in typography—and numerous excellent photographs relieve its 300 pages of text.

The Anaerobic Bacteria and their Activities in Nature and Disease

A Subject Bibliography. By Elizabeth McCoy and L. S. McClung. Vol. 1: Chronological Author Index. Pp. xxiii+295. Vol. 2: Subject Index. Pp. xi+602. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1939.) 50*s*. net.

THE material assembled in these two volumes consists of an index to the bibliography of a subject which is unusually scattered. Spore-forming and non-spore-forming species of anaerobic bacteria have come under review and 10,500 original articles published up to the end of 1937 are cited. In vol. 1 is found a chronological list of all the references arranged alphabetically under the authors' names; complete cross-reference entries are included for each of the joint authors together with the full title of each paper, a task involving approximately 120,000 entries. Vol. 2 consists of a general subject index, the references again being listed chronologically under the author's names; in this volume, however, the title of the paper is not given but can be obtained by reference to vol. 1.

On first inspection the subject index outline appears adequate, but in practice the inherent difficulties of the system are all too quickly apparent. For example, if one desires to know the published work concerning the production of *Cl. welchii* antitoxin, one turns to vol. 2 and finds under the general heading of "Antitoxins" more than 400 entries on the general problem of antitoxin production for any of the anaerobes. Further, the absence from vol. 2 of the titles to papers compels one to refer for each entry to vol. 1; obviously an impracticable task. In the absence of a more clearly defined classification of both spore-forming and non-spore-forming species, it is difficult to see how the authors could have overcome this practical problem. If in future editions of this work vol. 1 was allowed to lapse and remained in the archives as a historian's guide, and the subject-matter of vol. 2 was expanded to include the title of papers the difficulty would, in part, be solved and our searchings simplified. The authors could not have hoped that the system of indexing they have adopted would be generally acceptable by all classes of workers, but they must be gratefully thanked by research workers and historians alike for undertaking the formidable task of collecting and collating such diffuse material.

Everyday Fare for Fitness

By Dr. Stanley B. Whitehead. Pp. 166. (London: John Lane, The Bodley Head, Ltd., 1939.) 5*s*. net.

THIS little book, of which the author is an advocate of meatless fare, is divided into two parts. The first deals with what he regards as the merits and demerits of everyday food from the point of view of fitness. Everyday meals which he considers suitable for the manual worker, brain worker and nervous type are described, and tables are included of body-building foods, energy-providing foods, heat-producing foods, and health-protective foods. The second part contains more than two hundred recipes under the headings of breakfast dishes, salads, savouries, roasts and entrées, soups and broths, egg dishes, sweets, puddings and health drinks among which alcohol finds no place.

PHYSICS

Rheology of Suspensions

A Study of Dilatancy and Thixotropy. By Hugo Levin Röder. Pp. xiv+86. (Amsterdam: H. J. Paris, 1939.)

DILATANCY (the Osborne-Reynolds phenomenon) has proved more difficult to measure quantitatively than has any other rheological anomaly, and the author's failure to obtain satisfactory data for dilatant systems with a modified Stormer viscometer is therefore not surprising.

Röder goes on to describe an apparatus in which a small sphere, rigidly attached to a car drawn on rails by means of a weight, is swept through the material to be investigated. The friction of this arrangement is considerable, but in the case of a true fluid there is satisfactory proportionality between the applied weight and the rate of shear if a constant friction term is subtracted from the weight. Aqueous pastes of quartz and rice starch give initially a rise in rate of shear as load is increased, but finally settle to a constant rate independent of further loading. In carbon tetrachloride, the same materials show a thixotropic, instead of a dilatant behaviour, and comparison is made with the thixotropic properties of paints. In dilatant systems, the material 'builds up' in front of the shearing body like snow against a snow-plough, a phenomenon similar to that described by Jordan as occurring in the straining of muscles. The thesis ends with a rather inadequate summary of selected books and papers on thixotropy and dilatancy.

Röder's work will be welcomed as making definite progress towards a solution of the important industrial problem of the measurement of dilatancy, but it is to be regretted that the author does not deal more adequately with earlier work, the thesis giving the impression of having been written somewhat hastily. G. W. S. B.

Décharge électrique dans les gaz

Par Prof. Marcel Laporte. (Collection Armand Colin, Section de physique, No. 216). Pp. 222. (Paris: Armand Colin, 1939.) 15 francs.

ELECTRIC discharge in gases is the subject of the new volume which Prof. Laporte has added to the useful series of monographs published by Armand Colin. It is remarkable how much information is contained in each of these small and inexpensive books; both the editor of the Physics Section, M. Ch. Fabry, and the author are to be congratulated on this addition to the collection. The first six chapters deal with the ionization of a gas in its various aspects, then come five chapters on various forms of discharge, and the last two are concerned with gas discharge tubes as sources of light, including white light. Honours students of physics would do well to study this book.

Theory of Heavy Quanta

Door Frederik Jozef Belinfante. Pp. xii+126. ('s-Gravenhage: Martinus Nijhoff, 1939.)

SINCE 1937, the evidence from the study of cosmic rays has increasingly pointed to the existence of a particle about a hundred times more massive than the electron, giving support to a suggestion of Yukawa's in 1935 that the forces binding protons and neutrons together in atomic nuclei might be connected with particles of about that mass. Since Yukawa's first paper, much theoretical work has been done and the subject has now reached a stage when a general survey is possible. Unluckily the new particle does not readily lend itself to direct laboratory investigation, and there are still many possible formulations of the theory, all of which have to be elaborated until further indirect comparison with experiment is possible.

It is therefore natural that this tract should deal mainly with mathematical methods and be more useful to the theoretical physicist than to the experimenter. Actually the latter will get even less from it than would have been possible had the material been more suitably presented. The exposition lacks conciseness, and the discussion of the practical conclusions from the theory suggests wide but ill-digested reading. The mathematical style is not elegant; too many symbols are introduced, and equations which could be written more concisely confusingly cover half a page in vector notation at a stage when this is unnecessary. At the present stage of the theory it is of course difficult to choose the best mathematical apparatus; the author advocates the use of "undors", which are expounded in a preliminary chapter.

PSYCHOLOGY

New Ways in Psychoanalysis

By Dr. Karen Horney. Pp. 313. (London: Kegan Paul & Co., Ltd., 1939.) 12*s*. 6*d*. net.

THIS book is an attempt to evaluate critically some of the main assumptions underlying the Freudian system. After a somewhat verbose discussion, the author arrives at the conclusion that most of these assumptions have to be discarded and others substituted in their stead.

The argument begins with the assertion that Freud was too much influenced by the mechanistic philosophy of the nineteenth century. His theories of fixation, regression, repetition-compulsion, and of the supreme importance of infantile experience are instanced as types of mechanistic rather than of dialectic thinking. According to Freud, present manifestations of neurotic behaviour are not merely conditioned by the past, they contain nothing but the past. The mechanistic biology of Freud's early days, according to which evolution was merely a redistribution of existing elements, found in his theories a psychological expression. Likewise, his tendency to view psychic processes as pairs of opposites appears to the author as an expression of the dualistic thinking prevalent in the last century, whilst his notion of behaviour as the direct derivative of instinctive patterns is regarded as without basis in fact.

The reader will welcome this critical approach to the subject. He will also welcome the new stress upon sociological and cultural influences in fashioning human behaviour, for he will find this in accord both with current experimental results in the field of conditioning and with the growing realization among social psychologists that the key to motivation is to be sought in the nature of the social environment rather than in innate patterns of conduct. That neurosis arises in particular as a result of the struggle to cope with a hostile competitive environment is perhaps the most interesting point raised in the book. This belief is based on the author's assumption that the dominant human need is for security—principally in the economic sphere.

Laboratory Investigations into Psychic Phenomena

By Hereward Carrington. Pp. 255+25 plates. (London: Rider & Co., n.d.) 15*s*. net.

THIS volume is a useful handbook for those psychical researchers who want to have by them a well-documented and fairly critical account of the attempts that have been made to bring so-called supernormal phenomena into the laboratory and to subject them to tests made by instruments of precision.

After a brief historical introduction the author continues by describing the results of his own experiments, which consisted for the most part of an investigation of the validity of the instrumental tests which had been devised in the past. It is in this section that we meet again with the rather pathetic attempts to demonstrate such alleged phenomena as special human radiations proceeding from hands or eyes; the effect of the will on material objects; or some sort of instrumental communication with the spirit world. In his experiments, designed to repeat the results claimed by earlier enthusiasts, Mr. Carrington met with but little success, and he points out how, in a number of cases, the previous results may have been due to mechanical defects in the apparatus employed, faulty procedure during the experiments, or more simply still to a false interpretation of the readings given by the various devices.

In trying to repeat many of these attempts Mr. Carrington has done a useful work, and the record here printed, even though largely negative (and indeed because of it), will be found to be a wholesome corrective to those who follow in the path of his predecessors, and again attempt to introduce dynamoscopes, magnetometers, sthenometers, volometers and the rest.

TECHNOLOGY

Photography, its Principles and Practice

A Manual of the Theory and Practice of Photography. By C. B. Neblette. Third edition. Pp. xi+590. (London: Chapman & Hall, Ltd., 1939.) 30*s*. net.

ALTHOUGH photography enters very largely into all branches of scientific research, many investigators have only the most rudimentary knowledge of the characteristics of the materials with which they work. No doubt much time and trouble might have been saved had that information been available at the time of experiment. This well-known book—now in its third edition—is just the kind of manual for a scientific worker who is not specially interested in the theory of photography, but who desires a proper scientific account of all the processes of photography in order that he may use the tool to the best possible advantage.

The volume deals with every phase of photography, beginning with the camera and its optical system, emulsions, latent image and sensitometry. The whole of processing to the finished print is given in detail. Even the less usual types of printing process are described in such a manner that they may be practised. Colour photography is dealt with, but in less detail. One very good feature of the book is the system of quoting references. The necessary references immediately relevant to the text are given, but in addition there is on nearly every page a series of references to general articles so that any given topic may be followed up in the photographic literature. 'Neblette' is therefore a useful addition to the library of anyone having to practise photography in a scientific laboratory. It is no less useful to the serious amateur photographer with a limited knowledge of chemistry and physics.

Theory and Design of Valve Oscillators

For Radio and other Frequencies. By Dr. H. A. Thomas. (Monographs on Electrical Engineering, Vol. 7.) Pp. xvii+270. (London: Chapman & Hall, Ltd., 1939.) 18*s*. net.

THE thermionic valve occupies a unique place in the field of communication engineering, in which its use in the generation of oscillations is a particularly important aspect.

The present monograph aims at bringing together all the important work which has been done on valve oscillators of the usual types. Particular attention is given to a detailed theoretical examination of the factors which affect the character of the oscillation. Here, then, one finds, after a preliminary survey of fundamental principles, chapters devoted to efficiency, wave-form and frequency of oscillator systems. In dealing with frequency, the treatment is very full. The frequency changes induced by time changes in the oscillatory circuit itself are given the importance they deserve in a scientific presentation of the subject. Finally, the question of frequency stability is surveyed in all its ramifications.

Dr. Thomas has presented his subject in a clear and ordered way. Due to his expert knowledge, he is able to lay bare the core of a problem with a conciseness that is admirable. This is a book which radio engineers, particularly those on the research side, will find really helpful. L. J.

A Handbook on Ventilation, including Air Conditioning

By Percy L. Marks. Pp. viii+138+1 plate. (London: The Technical Press, Ltd., 1938.) 7*s*. 6*d*. net.

THIS short treatise is not concerned with theories but confines itself to established facts and usage and, in some cases, expresses the views of consulting engineers and manufacturers recognized as experts. The author has adopted a discursive style and, after presenting the general considerations, goes on to describe the several methods employed in various circumstances and the fittings and material used. On the activities of dry rot some valuable information is given, and there is a chapter of ventilation suggestions for different classes of buildings which should prove useful. While the book does not go nearly far enough into detail to constitute an independent guide, it would make a valuable addition to a more formal text-book by reason of the numerous practical ideas it contains.

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NEWS AND VIEWS

Sir Benjamin Baker, F.R.S. (1840–1907)

It is just fifty years ago this month since the famous Forth Bridge was opened and a hundred years ago since one of its designers, Sir Benjamin Baker, was born. The son of Benjamin Baker of Carlow, Ireland, Sir Benjamin was born in Somersetshire on March 31, 1840, and at the age of sixteen was apprenticed at the Neath Abbey Iron Works, South Wales. At the age of twenty he entered the employ of a civil engineer in London and two years later began his long association with Sir John Fowler (1817–98), who was then engaged on the construction of the first part of the London Underground Railway. Baker first gained recognition by a series of articles in *Engineering* in 1867 on "Long-Span Bridges". This series was followed by others on beams, brickwork and urban railways. In the 'seventies plans had been drawn up by Sir Thomas Bouch for a bridge over the Firth of Forth, but the failure of his Tay Bridge led to a reconsideration of the scheme.

In 1881 the railway companies interested requested their consulting engineers T. E. Harrison, W. H. Barlow and Fowler, with whom Baker collaborated, to report on the feasibility of a bridge over the Forth, and the type of bridge. The report recommended a cantilever bridge with a central supported girder, a type first adequately treated by Baker in his articles of 1867. The great work was begun in 1883 and completed in 1890, Baker then receiving the honour of knighthood. The second great work for which Baker will be remembered is the Aswan Dam on the River Nile, 6,400 ft. in length, carried out in the years 1898–1902 at a cost of £3,250,000. He was consulted regarding many projects both at home and abroad, acted as an arbitrator, and served on many commissions and committees. He was elected fellow of the Royal Society in 1890, and served as president of the Institution of Civil Engineers in 1895. He died unmarried on May 19, 1907, and was buried at the village of Idbury in the Cotswolds. Two years later a memorial window to him was erected in the north aisle of Westminster Abbey.

Substitutes for Imported Fuels

In the House of Commons, on March 20, Mr. Geoffrey Lloyd, Secretary for Mines, stated that Sir Harold Hartley had been appointed honorary adviser on the development of home-produced fuels. A number of leading representatives of industry, finance, and technical science, under the chairmanship of Sir William Bragg, had been asked to make a rapid survey of the subject in the light of war conditions, and within a month this authoritative body completed its survey. On its recommendations the following six specific problems are being investigated simultaneously: (1) the production of oil from coal by synthetic processes, under the chairmanship of Sir William Jowitt; (2) the products of low-temperature carbonization, under Lord Henley; (3) the liquid products of high-temperature carbonization, under Mr. Davidson Pratt; (4) alternative fuels for internal combustion engines, under Viscount Ridley; (5) the development of the use of colloidal fuel, under Mr. Irvine Geddes; and (6) the more efficient use of fuel generally, under Sir Clement Hindley.

A report has already been received, Mr. Lloyd said, on the recovery of benzole. This indicates that already additional crude benzole is being recovered at the estimated rate of 15,000,000 gallons a year, and that an extension of voluntary effort should secure a further 12,000,000 gallons a year. A survey has also been completed which shows how our production of tar, creosote, and pitch can take the place of imported fuel oil and bitumen to the extent of some 300,000 tons in the current year. Mr. Lloyd stated in conclusion that action already taken on the basis of reports received will result in obtaining in the current year some 32,000,000 gallons of substitutes for imported oil.

Economic Aspects of War

The economic aspects of war are ably discussed by Mr. G. Crowther in an Oxford Pamphlet on World Affairs (Oxford: Clarendon Press. 3*d.* net), entitled "The Sinews of War", in which he maintains that war is now an industrial proposition, being more influenced by the science of economics than by the art of strategy. The demand of war for the whole of a nation's industry and wealth has given an immense advantage to the rich country. Limiting himself to the question of men and materials, Mr. Crowther compares the resources of man-power and materials available to the Allies and to Germany. In almost every respect the Allies have an overwhelming advantage, and our advantage in man-power will increase the more Germany succeeds in making her raw materials at home. To win the War, however, even with these advantages, economic mobilization is essential. We must keep the seas open to our trade while closing them to the enemy; we must prevent the enemy from over-running our industrial areas or bombing them out of existence before they convert our advantages of man-power and materials into a military superiority. We must also preserve our ability to pay for imports by maintaining and increasing our export trades, and be prepared to reduce to the minimum the amount of man-power and materials consumed for purposes other than war. Finally, we must be energetic and speedy in organizing the transfer both of men and materials into their war-time jobs. In laying down programmes of war production, we must be content with nothing short of the maximum that is physically possible.

Tuberculosis and War

IN a recent paper on this subject (*Paris méd.*, 1, 52; 1940), Dr. E. Rist, of Paris, remarks that war favours the extension and aggravation of tuberculosis not only in belligerent nations but also in neutral countries, owing to the economic disturbance caused by the blockade, the scarcity of indispensable articles due to the destruction of merchant shipping and the hindrances of all kinds offered to the transport of goods by land and sea. During the War of 1914–18, the mortality curve from tuberculosis, which had fallen from 1900 to 1914, rose sharply from 1915 to 1918, and did not decline again until after the conclusion of peace. Among the numerous causes of an increase of endemic tuberculosis in war-time, one of the most serious is the rapid and wholesale evacuation of urban and rural populations to districts which are not sufficiently prepared to receive them, with the result that numerous healthy persons become infected with tuberculosis by those suffering from an active form of the disease.

Another factor leading to increase is the interruption of the most successful method of treatment of pulmonary tuberculosis, consisting in various forms of collapse therapy, especially artificial pneumothorax, caused by evacuation of patients to areas where there are no practitioners familiar with the technique. Other factors found to be responsible for the spread of tuberculosis are overwork, especially among those engaged in war industries of various kinds, under-feeding, as was illustrated in Denmark during 1914–18, and mental worry, the importance of which was emphasized by Laennec long ago. In conclusion, Dr. Rist, while admitting the necessity of an ample supply of tuberculosis experts in the armed forces, emphasizes the importance of restoring to civil practice a large number of them who are employed on quite unsuitable duties.

British Museum (Natural History)

LECTURE tours in the British Museum (Natural History) on Saturdays at 3 p.m., and on the first Sunday in each month at 3 p.m. have been arranged. London museums are re-opening their doors, and although many treasures have had to be moved away to safety from the Natural History Museum, their places have been filled to some extent by special exhibitions and new grouping. Two of the galleries are being used for a special exhibition to show Nature in the service of man. The exhibits illustrate the animals and plants from which our most important textiles are produced; sources of oil, animal, vegetable, and mineral, and some of the industries in which the various oils are needed; materials from which cosmetics and surgical requisites are prepared; the use made of spiders' webs and the origin of domestic breeds of poultry, cattle, pigs, etc. There is a section showing the animals particularly useful in war, such as white mice, canaries, reindeer, and Airedale dogs. Another gallery which has been proving a great attraction during the few weeks of limited opening is the Whale Hall, where a full-size model of a Blue Whale 92 feet long is on view—a treasure certainly, but much too large for evacuation!

Night-Shining Eyes

MOST people are familiar with the greenish gleam which shines from the eyes of a cat when a beam of light is directed upon them at night, and are aware that the glow can be seen only when the observer's line of vision is closely parallel with the beam of light. The phenomenon has been investigated in many animals by E. P. Walker, assistant director of the National Zoological Park of the Smithsonian Institution, and his results are referred to in the current Year Book of the Institution. The apparatus used in the tests was a reflecting head lamp, similar to a hand torch, worn on the forehead and connected with a three-cell battery in his pocket. The best results were obtained with a beam of moderate intensity, the effect of an intense beam being to make the glow less conspicuous or entirely to prevent its appearance. The shining is due to reflection from some surface in the eye, but its colour and character vary with the kind of animal. Colour ranges ran from silvery to blue-green, pale gold, reddish-gold, brown, amber and pink, and while most resembled reflection from a burnished metal surface, those of crocodiles and alligators gave the observer the impression of gazing into "a brilliantly glowing pinkish opening in a dull-surfaced bed of coal".

In the case of glowing eyes, the appearance is as if one looked through the pupil of the eye and saw reflection from the surface of the retina, but where the gleam was metallic in character there was no impression of looking into the interior of the eye. In the latter case, however, a difficulty arose because in most cases the reflection disappeared at a distance closer than from eight to twenty feet, so that the actual reflecting surface could not be determined. In some forty species of mammals and reptiles tests were made with red and blue coloured beams of light, but these made little change in the reflected gleam except to add a corresponding tinge of red or blue, a result which confirms the suggestion of simple reflection without any real animal light. To some degree there is a family resemblance in the character of the gleams, for most rodent eyes shine dully in brown, hazel or amber, although in porcupines the reflection is brilliantly silver. No shine was obtained from the eyes of higher apes or monkeys and no proof of the alleged shining of human eyes, yet, curiously enough, the most brilliant reflections of all were from the eyes of two of the lemurs, the slow loris and the potto.

Ethnological Reconnaissance in New Guinea

MUCH of the Mandated Territory of New Guinea is still uncontrolled, and even unexplored. Notwithstanding the difficulties of the country, the policy of exploration with a view to control is pursued with as little intermission as circumstances allow and has made substantial additions to knowledge in the information collected relating to the culture of previously unvisited or unknown peoples of the interior, notably in the regions adjacent to Mt.

Hagen. A recent report to Sir Walter McNicoll, administrator of the Mandated Territory, by Mr. J. L. Taylor, assistant district officer, records the results of a patrol carried out by him in unexplored country westward from Mt. Hagen to the border of Dutch New Guinea, and northward towards the southern tributaries of the Sepik River during March 9, 1938–June 19, 1939. The area surveyed consisted of some 20,000 square miles, and was found to be for the most part of temperate climate, such as might be suitable for European occupation. The future of the country traversed is said to lie in agriculture and pig-raising.

Large numbers of natives were encountered, most of whom appear to have been friendly, though on more than one occasion the patrol was attacked and suffered some casualties. Among natives to the north-west of Mt. Hagen, who had not previously seen a white man, the members of the patrol were regarded as spirits of the dead returned to earth. One of them, while taking observations from a tree, received the offering of a pig and was asked to ascend to heaven. In another village, the women were kept at a distance in the belief that they would die if they beheld these spirits. Among the more remarkable features in the culture of the peoples encountered, of which some particulars are given in a dispatch from the Canberra correspondent of *The Times* in the issue of March 26, is a system of deep drains or sunken roads, in the form of an elaborate complex of trenches, which serves both for defence and in cultivation as an effective drainage system, or as a protection against the ravages of pigs. Another remarkable culture trait is the use of wigs of human hair, made by professional wig-makers. Each man, it is said, aimed at having at least one wig made of his own hair. The tribes of the area were found to be keen traders, the most important and much sought after commodity being salt prepared from wood burnt after saturation in salt-springs.

Archæological Investigations in Jerusalem

Excavation of the remains of certain of the ancient walls of Jerusalem carried out by Mr. C. N. Johns on behalf of the Department of Antiquities has produced results of considerable archæological interest and historical importance. These results include the establishment of a chronological sequence in the remains of these ancient walls, which carries back to pre-Herodian times—certainly to the Maccabees and possibly even to the days of Nehemiah, although the evidence for the latter is archæologically undated. A further result is the confirmation of a tentative identification, made in the seventies of the last century, of the so-called Tower of David with Phasael, the third of the three towers described by Josephus as erected by Herod the Great. The systematic exploration of the site was made possible by the demolition of the Turkish barracks under the British occupation, and was undertaken by the Department of Antiquities in 1934 through the direct personal interest of Sir Arthur Wauchope, then High Commissioner.

The excavation, as described in a dispatch from the Jerusalem correspondent of *The Times* in the issue of March 23, has laid bare the old wall inside and parallel to the present north and west walls of the Citadel as reconstructed by the Crusaders and Mamelukes. This fragment of the old wall consists of three towers, Phasael and those named respectively by the excavators the Corner Tower and the South Tower, and their connecting curtain walls. The curtain between Phasael and the Corner Tower is of crude chalky stone solidly laid without mortar on the native rock scarp. Stratified remains of pottery suggest that this may go back to Jonathan Maccabæus; but in fact it incorporates an even earlier and clumsier wall, as previously mentioned, archæologically undated. The Maccabæan wall was partially demolished shortly after its erection, in a battle, presumably during the sieges by one or other of the Antiochus dynasty, of which the relics are seen in iron and bronze javelin heads and stone ballista balls. There is now evidence that after repairs it was reconstructed in the remarkable protective works of Herod, in which the tower Phasael was the strongest and most striking, rising from a cube of solid masonry, measuring 68 ft. on each side, in two stages to a height of 155 ft. In addition to their intrinsic interest, these discoveries will tend to throw light on other problems of the character and appearance of the Holy City at the opening of our era.

Trotula and the Ladies of Salerno

In a paper read before the Section of the History of Medicine of the Royal Society of Medicine on January 10, Dr. H. P. Bayon stated that several contemporary writers maintained that a fictitious Trottus was the author of "De passionibus mulierum", which was usually ascribed to Trotula of Salerno, a matron mentioned in the text of most manuscript copies and therefore a definite person. Whether she wrote or compiled the chapters "De ornatu mulierum" is not ascertained, but a study of early manuscript texts dealing with cosmetics seems to afford some clue. The gynæcological chapters are notable because of the recommendation of the support of the perinæum in childbirth and the primary suture of the perinæum. The many manuscript copies, printings and literary allusions concur in showing the appreciation which Trotula enjoyed during the twelfth to sixteenth centuries.

The references in the text of Trotula's work to Saracens, many drugs from the East, the avoidance of magical formulæ and hagiology, together with the description of alchemical manipulations, indicate the personal influence of Moslem and Hebrew physicians; in other Salernitan writings, quotations from the Old Testament are preferred. It is recorded that Costanza of Salerno lectured on medicine during the reign of Giovanna I of Anjou (1326–82); she was probably the first woman professor. The decline of the College of Salerno must have occurred after its destruction in the sack of the town in 1194. In academical teaching Salernitan doctrines were replaced by dialectic scholastic medicine, but the

College of Salerno brought to the West a system of professional medical practice which has since prevailed in all parts of the civilized world.

A New Kind of Museum Exhibit

THE New England Museum of Natural History in Boston, Mass., has been the first to turn a trade innovation in lighting to the service of museum galleries. In the particular case described by Bradford Washburn in the *Museums Journal* (39, 450; 1940) you gaze at a stoat watching you from the edge of a summer wood. As you look, the lights fade, become momentarily dim, and when the full light shows again the summer scene has gone, snow covers the ground, the trees are bare of leaves, and the stoats have changed into their winter dress of ermine. The case really contains two groups, a summer and a winter one; but the spectator looking at the summer group perceives it, when it is brilliantly lit internally, through a transparent sheet of Belgian 'black' glass. When the internal lights fade and the second group is illuminated, the black glass becomes opaque and acts as a mirror in which only the snow scene is visible, exactly overlapping the summer scene, of which it is a replica in reverse. Many technical difficulties had to be surmounted before the new exhibit was satisfactorily completed; but its dissolving habitat group at once made a great impression. One wonders if the average mortal really needs such bait in order to be induced to look at a representation of Nature: and the result—half his mind is thinking about the trick of the thing; only the other half is giving itself to the study of the Nature group.

Earthquakes Near Great Dams

ACCORDING to *Earthquake Notes* (11, No. 3; January 1940), earthquakes of varying intensity have been recorded from the neighbourhood of Boulder Dam since September 1936. During the first four months twelve shocks were felt, but the frequency increased until during April 1937 forty-five were felt. After this time the frequency increased until during the early part of 1939 there were on average two humanly felt earthquakes a month. The Wood-Anderson seismograph on the spot recorded more than five hundred disturbances during 1938. There has been some discussion among U.S. seismologists of plans for the observation of possible earthquakes in the neighbourhood of two other areas which will probably be similarly loaded. The first is the unfinished Grand Coulee Dam in the State of Washington, and the second is the proposed Shasta Dam near the confluence of the Pit and Sacramento Rivers in northern California. In the latter case there is yet time to obtain information of the seismicity of the area before loading. Similar data were not obtained in the case of the Boulder Dam.

Oxygen Administration and Inhalation Apparatus

A FIFTH memorandum in the Emergency Medical Services Series has been issued by the Ministry of Health entitled "Oxygen Administration—Indications, Methods and Types of Apparatus" (H.M. Stationery Office. 2*d*. net). The administration of oxygen is a valuable aid in the treatment of some forms of gas poisoning and lung disease, and in some surgical conditions such as shock and chest wounds. The memorandum incorporates the results of research on the subject, and is intended primarily for the guidance of medical officers in charge of hospitals. It describes the conditions for which oxygen therapy is likely to be effective, methods of oxygen administration, and the more important types of apparatus for the purpose, including a new form of nasal mask.

Alexander Pedler Lecture

THE Alexander Pedler Lecture, which is given annually under the auspices of the British Association, was this year delivered by Prof. Allan Ferguson before the Cardiff Naturalists' Society. The lecture, which was given in the Reardon Smith Lecture Theatre of the National Museum of Wales, Cardiff, on March 14, was entitled "Splashes, and what they Teach". It was chiefly concerned with an explanation of the phenomena attendant on the impact of a drop of liquid on a liquid or solid surface. A high-speed film was shown which illustrated the phenomena, and the results were compared with those of the earlier classical experiments carried out by the late Prof. Worthington.

Old Books on Social Sciences

WE have received a copy of Catalogue 54 published by E. P. Goldschmidt and Co., of 45 Old Bond Street, W.1, containing 307 items of old works dealing with a great variety of subjects. Attention may be directed to the following: Jacques Legrand's "Sophologium", a popular handbook of useful knowledge, possibly printed by Caxton, not later than 1473; Naudé's work on the principles of librarianship and library organization (1627); Beccaria's treatise on crimes and penalties (1766); Sir Edwin Chadwick's "Report on the Sanitary Condition of the Labouring Population of Great Britain" (1842); Patissier's work on factory hygiene and the diseases to which miners, industrial workers and others are exposed (1822); Schreiber's sixteenth century book on practical arithmetic, the first German book on the subject; Jérome de Monteux's treatise on hygiene, which contains chapters on dietetics, the care and nourishment of children, and a section on cosmetics (1559); Bernard Palissy's discourse on the nature of waters, fountains, rains, metals, salts, stones, earths and fire (1580), which entitles him to be regarded as one of the pioneers of modern chemistry and geology; Neander's "Tabacologia" (1626), the most important early work on tobacco; Villafranca's "Methodus refrigerandi" (1550), the earliest work on artificial refrigeration; and the first edition of Linnæus's book on the increase of the habitable earth (1744) bound up with the second edition of his oration on travelling in one's own country (1743).

Hydro-Electric Development in India

In Nature of January 6, p. 23, under this heading, it was stated that an irrigation scheme involving the generation of large quantities of electric power between the Punjab and the State of Bilaspur "is under construction". We are informed by the secretary of the Central Board of Irrigation that "the project referred to, namely the Bhakra Dam Project in the Punjab, is not 'under construction' but simply 'under consideration' at present".

Exhibition of Chinese Art at Leeds

An exhibition of Chinese art was opened in the Temple Newsham Mansion, Leeds, on March 23 by Dr. Thomas Bodkin, Barber professor of Fine Arts and director of the Barber Institute in the University of Birmingham. The exhibition consists of more than 200 specimens of pottery, paintings and bronzes, exhibited by the courtesy of Messrs. John Sparks of London, and on the initiative of the curator of Temple Newsham, Mr. Philip Hendy. Although the exhibition is, so far as possible, comprehensive in a chronological sense, the periods which will appeal most to students of the earlier phases of Chinese culture, covering the Shang-Yin (? 1766–1122 B.C.) and Chou (? 1122–249 B.C.) Dynasties and the Warring States, are represented by some notable exhibits forming a group of seven very rare bronzes. Three belong to the Shan-Yin Dynasty—two beaker-shaped vessels with a finely engraved design, and a sacrificial cup. There are also three vessels of the Chou Dynasty; and a dagger with a handle in the form of a mule's head is of the period of the Warring States (481–221 B.C.). Special interest is attached to these bronzes, all coming from burials. Among the most important of the pottery exhibits is the figure of a Lohan or Buddhist priest, seated with arms folded in the sleeves of his cloak, which stands about four feet high.

A Big Sunspot

A big sunspot has crossed the solar disk during the past week; appearing at the east limb on March 20, reaching the central meridian on March 26·3 and due to pass around the west limb of the disk on April 1. The area of the spot on March 23 was 1,000 millionths of the sun's hemisphere—an area well above the lower limit of size for naked-eye visibility. On March 23, a bright chromospheric eruption of considerable intensity was observed directly over the spot. A great magnetic storm began on March 23 and was in progress during the night of March 24–25, when the aurora was also seen in spite of bright moonlight. Widespread interference with both radio and cable communications was reported.

The Night Sky in April

During the month, night shortens by nearly two hours in the latitude of London. The moon is new on April 7 at 20·3h. and full on April 22 at 4·6h. On the latter date, a penumbral eclipse of the moon occurs, having been preceded on April 7 by an annular eclipse of the sun invisible in Great Britain, but to be seen in the southern parts of the United States of America. The penumbral lunar eclipse on April 22 begins at 2h. 27m., reaches a maximum phase (0·89) at 4h. 26m., and ends at 6h. 25m. In the nature of things, a penumbral lunar eclipse is not a spectacular phenomenon, but a difference in brightness between the east and west parts of the moon's disk should be discernible in a naked-eye scrutiny. In the evening skies after sunset, the brilliant planet Venus dominates the other planets still above the horizon—Mars, which is visible for about three hours after sunset, and Saturn, drawing nearer to the sun's position until it is in conjunction on April 24. Jupiter is now too close to the sun for observation, being in conjunction on April 11. It may be noted that also on April 11 at 0h. Venus is in conjunction with Mars; while at 19h. the moon, then nearly four days old, will be in conjunction with both these planets. The Lyrid meteors are due during April 19–22, the radiant point being near 104 Herculis. [All times are given in Universal Time; add 1 hour to convert to Summer Time.]

Announcements

Sir Harold Carpenter, F.R.S., professor of metallurgy in the Royal School of Mines, London, has been awarded the Honda prize of the Japan Metallurgy Society. He is the first foreigner to receive the award, which consists of a gold cup and £300.

Prof. A. V. Hill, M.P., F.R.S., has been appointed as assistant air attaché in Washington for special scientific liaison duties. The appointment is temporary, and has been accepted without remuneration.

The Messel Medal of the Society of Chemical Industry has been awarded to Lord Samuel. This medal, one of the two principal awards in the hands of the Society, is given in alternate years for "meritorious distinction in Science, Literature, Industry or Public Affairs, and who is prominently concerned with the Welfare of the Society". The presentation will be made at the annual meeting of the Society to be held in London on July 9, when Lord Samuel will deliver an address.

The Kitasato Institute for Infectious Diseases, founded at Tokyo, by Baron Kitasato, who discovered the bacillus of bubonic plague and who died in 1931, celebrated the twenty-fifth anniversary of its foundation on November 5.

According to Dr. C. Louis Leipoldt, medical secretary of the Medical Association of South Africa, in Southern Rhodesia where there are 188 registered medical practitioners, 116 are available for service in the present national emergency.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 516. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Human Genera and Species

PROF. OSMAN HILL's suggestion[1] that the classification of the Hominidæ is in urgent need of revision is likely to meet with general agreement. It is doubtful, however, if the particular proposals which he puts forward will do more than deliver the question from its present confusion—a confusion which at least has the merit of attributing a glamorous if unreal diversity to human ancestry—into another confusion at least as great. This is certain to occur if the principles of zoological classification are as he defines them. The differences which he suggests indicate generic distinctions ("differences in external or internal structure") cannot be regarded as essentially different from those which he believes to indicate specific distinctions ("differences in bodily proportions . . . differences in bodily form", etc.). For, quite apart from the verbal and logistic difficulty of deciding what is a difference in "structure" and what is a difference in "form", there is strong reason for supposing that pronounced differences in the one or the other or both aspects of the body or its organs are often simply due to differences in growth-rates. For example, some monkeys have a vermiform appendix, others lack this structure. Osman Hill's criteria suggest that differences of this kind are necessarily a sign of generic distinction. The difference, however, is entirely dependent on a different pattern and rate of growth in the cæcal region of the large intestine, that is, on a process which in this case leads to an extreme difference in bodily proportions. These, however, Osman Hill regards as indicative of specific and not generic distinction. It would therefore seem that no real difference separates his criteria for defining genera and species. In any event it is difficult to see how they could be applied to fragments of fossil human skulls.

It is because systematists have never succeeded in devising any standards of general application that zoological classification remains the somewhat uneven structure that it is. In spite of all attempts at suppression, the personal factor still enters largely into decisions that this or that group of animals constitutes a species of a genus. Some systematists are 'lumpers', others 'splitters', and however much it may be regretted as indicative of a lack of objectivity, Tate Regan's remark[2] that a species is something which a competent systematist recognizes as such still holds. But this does not mean that arbitrary conventions are not devised and used which allow of fairly equal generic and fairly equal specific subdivision within a given group of organisms. It was in the belief that this was so that I suggested in 1931[3] that there was no reason to regard Java man (Pithecanthropus) and Pekin man (Sinanthropus) as generically distinct. This view was reaffirmed last year by Le Gros Clark[4] and has just been re-stated by von Koenigswald[5] and Weidenreich.

Any rigid set of principles of systematic classification based, as Osman Hill's are, on a supposed application of principles derived from other fields of biology, usually defeats itself. One has to be particularly careful about such principles in the study of human origins because, as I have suggested elsewhere[6], the importance attached to this question, and the consequent and inevitable derivation of views on primate phylogeny from primate classification, make it essential that the genera within a single family, or the species within a single genus, should be at least approximately equivalent in their taxonomic differentiation, if the theoretical condition is to be fulfilled that the sub-groups of a given genus or family can be regarded as more closely related to each other by descent than they are to the members of other genera and families. This necessity applies to the whole field of palæontology. In a recent review of the problem, Arkell and Moy-Thomas[7] point out that every new genus and species of fossil should fit as nearly as possible into a uniform scale of classificatory values, and that classification should not be complicated by the introduction of preconceived, and usually arbitrary, views about phylogeny.

In the classification of the Hominidæ it is clear (*a*) that a difference which in one case serves as part of the basis for generic differentiation should be given equal consideration in another, and (*b*) that any common characters which bind the species of Homo into a single genus should not occur in any other genus of the Hominidæ. These are purely empirical and, to that extent, arbitrary criteria. But they are essential criteria if there is to be any order in the classification of the Hominidæ, and if views on human phylogeny are to be soundly based. The main difficulty that usually lies in the way of their application to the classification of any new human fossil skull is the desire to make too much of a good thing by magnifying its significance. This was certainly done, either consciously or unconsciously, in the case of the Pekin skull, and the only new fact which Weidenreich's recent announcement implies is that he has at last looked objectively at all the evidence which should have been taken into account at the start of his labours—for in my opinion[3] his conclusion was obvious from the moment Davidson Black published the measurements of the first two Sinanthropus skulls in 1930 and 1931[8], even though he, too, insisted on the distinctive generic separateness of the type. But in this, Black's successor in the excavations of Choukoutien has behaved no differently from almost every other discoverer of a fossil human skull, for the tendency to make too much of such a discovery appears to be irresistible.

An excellent example is provided by the recently described Swanscombe skull, which an impartial committee of experts set up by the Royal Anthropological Institute agreed, after exhaustive examination, differed in no significant way from modern human skulls[9]. In what amounts to a minority report, however, Marston[10], its discoverer, dissociates himself from this view and claims that the skull is much more primitive than this, even more primitive than the Neanderthal group!

If these controversies are to be avoided, it must be accepted by physical anthropologists that the species concept as used in systematics is artificial (however much meaning the term 'species' may have in another context, for example, ecological, as signifying a genuine biological unit), and that in consequence it is necessary to define the amount and kind of differentiation which, in the family Hominidæ, should determine either specific or generic status. At the present time there does not seem to be any more reason than there was ten years ago[3] for separating generically from one another in classification such archaic types as Sinanthropus, Pithecanthropus, Neanderthal and Rhodesian man. The only classification which still appears to be justified to-day is the separation of this group from a group comprising modern man, types belonging to the Upper Palæolithic, and such temporally aberrant types as the Swanscombe skull. The facts demand such a classification—whatever be its phylogenetic significance.

S. ZUCKERMAN.

Department of Human Anatomy,
Oxford.
March 2.

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[1] Osman Hill, W. E., NATURE, 145, 260 (1940).

[2] Regan, C. Tate, Rep. Brit. Assoc. Southampton, 1925 (1926).

[3] Zuckerman, S., *Eugenics Rev.*, 24, 1931 (1931).

[4] Le Gros Clark, W. E., *Modern Quarterly*, 2, 115 (1939); also Presidential Address to Section H, Brit. Assoc. Advance Sci. (1939).

[5] Von Koenigswald, G. H. R., and Weidenreich, F., NATURE, 144, 926 (1939).

[6] Zuckerman, S., "Functional Affinities of Man, Monkeys and Apes" (London: Kegan Paul, 1933).

[7] Arkell, W. J., and Moy-Thomas, J. A., in "The New Systematics". Edited by J. S. Huxley. (Oxford University Press, 1940).

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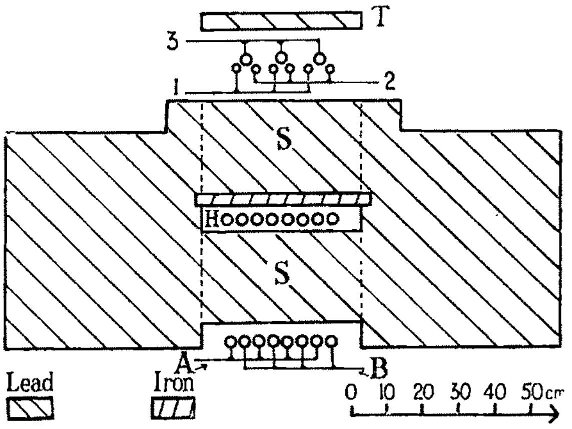
Penetrating Cosmic Ray Showers

It is now recognized that the majority of cosmic ray showers at sea-level consist of electron cascades (see, for example, Jánossy[1] and Lovell[2]). The present investigation gives evidence for the existence of a very small number of penetrating showers remaining after the cascades have been removed by suitable absorbers. The frequency of these penetrating showers, however, amounts only to a few per cent of all showers at sea-level. They therefore could not be detected in the experiments referred to above, or in the similar experiments of Schmeiser and Bothe[3].

The experimental arrangement is shown in the accompanying diagram. The counters shown joined with lines are connected in parallel, giving five-fold coincidences 1-2-3-*A*-*B*. Each five-fold coincidence registered corresponds to a shower containing more than one particle near the top counters as well as near the bottom counters. The eight counters *H* are placed in the middle of the absorber *S* in order to obtain evidence on the number of rays in the shower. These counters control small neon indicators in such a way that whenever a five-fold coincidence 1-2-3-*A*-*B* occurs, the lamps indicate the number *n* of the counters *H* which are discharged simultaneously with the coincidence. The neon flashes were recorded photographically. Some of the experimental results are collected in the table below.



Absorbers (cm. Pb)		Records containing *n* flashes (rate per 100 hour)		
T	*S*	$n = 0$ or 1	$n = \geqq 2$	$n = 0-8$
0	50	11 ± 2·5	8 ± 2	19 ± 3
Various thicknesses 1·8 – 10·0 cm.		32·5 ± 2·2	15·6 ± 1·6	48 ± 3

Since the bottom counters are effectively surrounded by 50 cm. of lead, each shower giving rise to a coincidence necessarily contained particles penetrating at least 50 cm. of lead whatever the direction of the shower particles.

It can be calculated that a cascade shower which penetrates 50 cm. of lead must have an initial energy of at least 10^{19} ev. If electrons or photons of this energy were sufficiently frequent to account for our observations, they would have to transfer an enormous amount of energy into ionization on their way through a lead absorber. This ionization can be shown to be larger than the total ionization produced by the whole cosmic ray beam, and would therefore be incompatible with the known rate of ionization. If, therefore, the Bethe-Heitler theory is valid for very high energies, the showers cannot be cascades.

A meson may produce two independent secondaries, one near the top and another near the bottom counters, and so give rise to a five-fold coincidence. In general, such a 'double knock-on' will give rise to a record $n = 0$ or 1, according as to whether the primary meson is, or is not, recorded by one of the counters *H*. In fact, the observed number of records $n = 0$ or 1 is in good agreement with the estimated rate of double knock-on processes. Only a small fraction of the double knock-on showers should produce independent secondaries near the counters *H* and so give rise to records with $n \geqq 2$. The observed rate of records $n \geqq 2$ is, however, more than 50 per cent of those with $n = 0$ or 1. We conclude, therefore, that the records with $n \geqq 2$ are *not* due to multiple knock-on showers. This conclusion would be invalidated if the cross-section for head-on collisions of mesons with electrons for energies above 5×10^{10} ev. should prove to be essentially larger than that calculated by Bhabha[4] or Massey and Corben[5].

Assuming, however, that the theories are correct, the records $n \geq 2$ must be interpreted as due to penetrating showers different from cascades and knock-on showers.

We have carried out experiments which suggest that these penetrating showers are connected with the extensive air showers. This is in agreement with the conclusions of Auger[6] and with recent experiments of Wataghin[7].

Though other interpretations cannot be excluded, it is plausible to assume that the observed showers contain several mesons simultaneously. The photographs of Braddick and Hensby[7] appear to show examples of two associated mesons.

Comparison of the coincidence rates for $T = 0$ and $T \geq 1{\cdot}8$ cm. shows that less than half the penetrating showers come from the air, while the rest are produced in the absorber T. It seems possible, therefore, that some of the observed showers are due to creation of mesons in the absorber T.

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P. Ingleby.

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Origin of Visual After-Images

It is sometimes disputed whether visual after-images are due to retinal or central processes. Their retinal origin appears to be capable of demonstration as follows. If one eye is pressed with the finger or a spring balance near the outer canthus for about thirty seconds, it will become temporarily blind. This effect, known to Thomas Young, Helmholtz and Donders, is attributed to retinal anoxæmia. The pressure should be about 250 gm., applied over an area of 1 sq. cm. The easiest method is to press on top of the lids, keeping them sufficiently far apart to permit vision. A brown mist will spread over the visual field, and finally all objects will disappear. The image of a bright light, such as a 60-watt bulb, at a distance of 1 m. or 2 m. should now be thrown on a fixed region of the retina in the blind eye.

The easiest method is to fixate the light with the other eye; the natural convergence of the two eyes will cause the other to remain stationary though the pressure will prevent the image from falling exactly on the fovea. Such fixation is maintained for two minutes; the normal eye may be closed for a second from time to time, to make sure that the other eye is still completely blind. If, finally, the head is turned away from the light and pressure removed an after-image of the light will, of course, be seen with the normal eye on any suitable surface, being dark on a bright background and bright on a dark one.

If the normal eye be closed and the other opened ten seconds or so after pressure has been released, its vision will be found restored, and *an after-image positive or negative, will be seen against a suitable background, though the stimulation from the primary image has never reached the lower and higher visual centres at all.*

The image will usually be eccentrically placed in the visual field, through lack of normal fixation, and may be blurred or multiple owing to eye-movements. It may also be feebler at first owing to incomplete recovery of vision in the pressed eye. Under suitable conditions, however, its similarity to the image in the other eye leaves no doubt that both originate in the same way. This confirms the view that the positive after-image seen on a dark ground is due to retinal after-discharge, and the negative image on a bright ground to local reduction of retinal sensitivity. Since these effects occur despite anoxæmia, their photochemical origin is confirmed. The same result is obtained if the unpressed eye has been closed throughout, but fixation of the blind eye is then very difficult and there is no normal image for comparison. It is not denied that central processes may exert an inhibitory influence on these after-images.

Induced anoxæmia of the retina thus provides a useful method of blocking impulses between the retina and the visual centres and of isolating the contributions of different parts of the system to the sensory process.

K. J. W. Craik.

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University, Cambridge.

Feb. 27.

Metabolism of Tumours

In a recent review[1] of the 1939 report of the British Empire Cancer Campaign, Dr. E. Boyland criticizes as "rather misleading" the following statement from the report of this Laboratory: "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring, secondly cancer tissue has a respiratory quotient indicating that the oxidation of carbohydrate is abnormal".

This statement, far from being misleading, seems to me to be clear and correct: tumour tissue differs from most normal tissues in these two respects. In an earlier report[2] we had stated our view at length: following our findings[3] that kidney medulla has a powerful aerobic glycolysis not only in Ringer solution but also, contrary to György *et al.*[4], in serum, we said[2]: "In these somewhat rare cases, therefore, aerobic fermentation is certainly not associated with growth, still less with malignancy. Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis". Later we studied cartilage[5] which we found[6] to have a similar type of metabolism. These are clearer examples than retina, since these tissues are probably no more damaged than in other tissue-slice experiments. Bone marrow glycolyses aerobically in Ringer's solution[7], though the preparation used by Fujita[2] had low aerobic glycolysis in serum.

Some of Dr. Boyland's other examples are less satisfactory. Liver[8,10], smooth muscle[10], diaphragm[11] and normal lymph glands[12,13,10] have all been reported with insignificant aerobic glycolysis compared with that of tumours. In fact, the transformation of normal liver into a hepatoma is a striking example[14,15] of the development from normal liver metabolism of "The type of metabolic activity characteristic of malignant tissue generally, that is, active glycolysis with a relatively high value for the aerobic glycolysis"[15]. This important result does not seem to favour the view that cancer tissue arises in general from normal tissue with a cancer-like metabolism.

Normal skin glycolyses aerobically and undergoes relatively little alteration of metabolism when it becomes papillomatous[16], but when muscle is replaced by malignant sarcoma a great increase of glycolysis occurs[16]. In observations of which details are not yet published, Berenblum, Chain and Heatley[17] found with isolated epithelium of skin and of Shope papilloma little difference of metabolism or of *R.Q.*, the latter being low in both. Thus their results on skin epithelium appear to resemble those of Bywaters[5] on synovial membrane. If we exclude retina, of which the *R.Q.* is controversial, these two examples represent the present exceptions among normal tissues to both our generalizations. Although both are tissues of low metabolic activity, it is likely that similar characteristics will be found in more active tissues as the search proceeds. It is clear that neither of our generalizations, nor both in combination, is in the strictest sense specific for tumours. Nevertheless, the association in tumour metabolism of relatively high aerobic and anaerobic glycolysis with the lowered *R.Q.* is such a constant one that to dismiss it is to discard as unimportant the most characteristic of established biochemical peculiarities of tumour tissue.

F. DICKENS.

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Newcastle-upon-Tyne.
Feb. 23.

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[17] *Ann. Rep. Brit. Emp. Cancer Campaign*, **16**, 215 (1939).

THE above letter contains two conflicting statements.

(1) "Aerobic glycolysis is not specific for tumours, though practically all tumours have strong aerobic glycolysis." This from Dr. Dickens's report of 1936 seems to be a fair and true statement of the position and not consistent with the following statement from the 1939 report, which I consider "rather misleading".

(2) "There appear at the present time to be two main points in which the metabolism of cancer differs from that of most normal tissues. Firstly the ability of cancer cells to form lactic acid persists even when the tissue is respiring."

Benign growths and most body tissues (with some exceptions, such as kidney cortex, spleen, ovary and lung) which have been carefully examined appear to have some aerobic glycolysis (for example. testis $Q_{L}^{O_2}$ 2·8–5·5, liver 0·9–4·3, uterus 3·0–6·9). Some of these non-malignant tissues, in addition to the three mentioned by Dr. Dickens, also have a lowered *R.Q.* A few malignant tumours, particularly some human carcinomata[1] and some spontaneous carcinomata in mice[2], have lower aerobic glycolysis than many 'normal' tissues.

There can be no doubt that the British Empire Cancer Campaign has in this, as in so many other problems connected with cancer, given most valuable help by securing the thorough investigation of the question in several different laboratories.

E. BOYLAND.

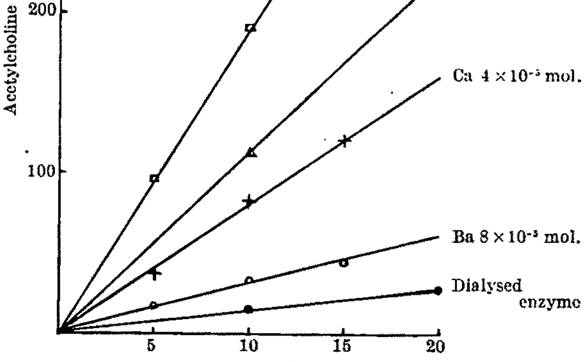
Chester Beatty Research Institute,
The Royal Cancer Hospital (Free),
London, S.W.3.
Feb. 29.

[1] Dickens, F., and Patey, D. H., *Lancet*, **2**, 1229 (1930).

[2] Murphy, J. B., and Hawkins, J. A., *J. Gen. Physiol.*, **8**, 115 (1925).

Action of Ions on Choline Esterase

THE physiological significance of choline esterase suggested by its high concentration at muscle end plates and at synapses of the central nervous system[1] makes it desirable to investigate the properties of the enzyme. The electric organ of Torpedo, which is considered as an accumulation of muscle end plates, has by far the highest content of choline esterase ever found in a tissue of fluid. An organ of 100–200 gm. weight splits about 200–400 gm. acetylcholine in 60 min., which is a hydrolytic power of the



ACTION OF DIVALENT IONS ON CHOLINE ESTERASE same order of magnitude as calculated for end plates. The organ has therefore been used as material for the preparation of active enzyme solutions[2].

Evidence obtained previously from these preparations indicated that the enzyme contains —SH groups essential for its activity[3]. The present investigations show that the enzyme is only active in the presence of divalent cations. After dialysis the enzyme practically completely loses its activity. A few γ of divalent ions reactivate it. The order of activation by the ions is as follows: Ba^{++}, Ca^{++}, Mg^{++}, Mn^{++} (see accompanying figure). Mn^{++} in a concentration of 0·00002 mol. (1·1 γ per c.c.) increased the amount of acetylcholine split in 60 min. from 0·08 to 1·13 mgm.

Meyerhof's co-workers described a strong effect of Mn^{++} on the action of cozymase[4] and cocarboxylase[5]. Mg^{++} was also active but to a smaller extent. v. Euler and his associates[6] observed that *iso*-citric dehydrogenase does not act unless Mn^{++} or Mg^{++} are present. In all three enzyme systems concentrations of the ions and relationships between the strength of Mn^{++} and Mg^{++} were similar to those described here.

The reactivation by cations occurs at a point different from that at which the reactivation by reduction of S–S groups takes place. The maximal effect of glutathione plus Mg^{++} is equal to the sum of the effects of each alone (see accompanying table).

SUM OF EFFECTS OF Mg^{++} AND GLUTATHIONE. MGM. ACETYLCHOLINE SPLIT IN 60 MIN.

	Values obtained	Calculated values
Dialysed enzyme	0·45	0·45
+ GSH 0·0003 mol.	2·20	+ 1·75
+ GSH 0·001 mol.	2·30	
+ Mg^{++} 0·002 mol.	1·85	+ 1·40
+ Mg^{++} 0·002 mol. + GSH 0·0003 mol.	3·67	3·60

Monovalent ions (Na,K) also reactivate the enzyme, but only at very high concentrations (0·1 mol.). However, even at such high concentrations the effect of the monovalent ions is much less than that of divalent ions. No difference has been found between K^+ and Na^+.

Our results and conclusions are in contrast to those recently described by Mendel *et al.*[7]. It should be borne in mind, however, that the enzyme preparations employed by those authors were obtained from horse serum and that they appear to have been less active and of a lower degree of purity than those previously described[2].

This work was aided by a grant of the Dazian Foundation.

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School of Medicine,
Yale University.

Feb. 7.

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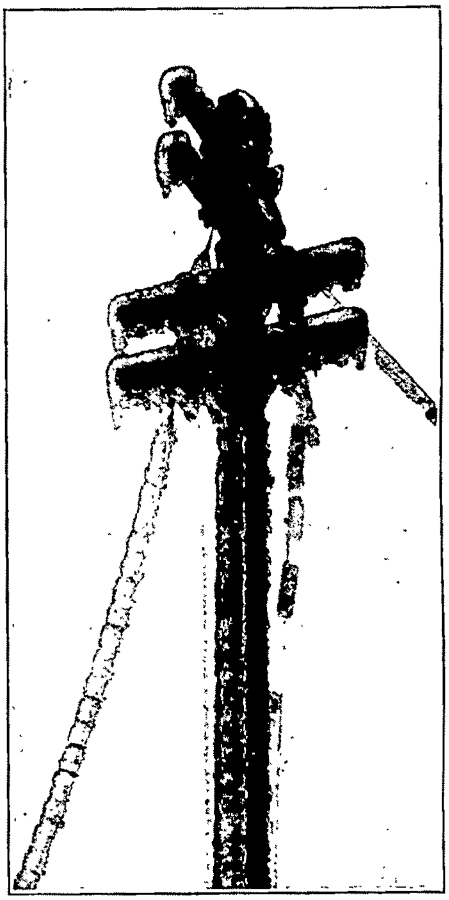
Ice Formation in Worcestershire

ON January 27, when the great snowstorm was developing, the Evesham district experienced a relatively light fall and this changed at night to 'supercooled' rain. Sunday, January 28, found us awaking to a strange 'creaking' of trees in the wind due, I found, to an armour of thick ice. Most of the ice was on top—my aerial had ¾ in. above, ¼ in. below. Wider exploration presented an amazing experience. Roads, walls, trees, hedges—everything was coated with inches of crystal clear ice. Branches and twigs were encased in ice many times their own diameter, and many were, like the telegraph wires in the accompanying illustration, either broken down or snapping as I passed. Slight rain was still falling and freezing instantly. There seems no doubt that rain had been falling all night in a 'supercooled' state, contact with objects initiating solidification, generally complete before the water could run underneath. People were chiselling their way into cars left outside, and ice on one near Broadway Tower was 6 in. thick.



I saw wood-pigeons, encased in ice as they roosted, hobbling through the grass. Presumably with the receipt of latent heat they had realized nothing untoward until attempting to fly. Roads themselves were sheets of ice—6 in. thick on Broadway Hill—and being used as skating rinks.

Quantitatively—ice 4 in. thick on twigs common, 'blades' of grass 4 in. thick; I measured one telegraph pole guy 18 in. in circumference; one branch weighed before and after thawing gave ratio 64 to 1, and on one fine grass blade the ice weighed 197 times the grass.

The whole appearance of the countryside was fantastic and grotesque, and it would be interesting to know if any previous similar occurrence is on record.

A. A. NEWBOLD.

The Haven, Greenhill,
Evesham.

Optical Anisotropy of Cellulosic Sheets

THE following observations on the optical anisotropy of cellulose ester sheets may supplement the findings of Drummond[1].

Whether the 'slow ray' in the plane of the sheet is normal to, or coincident with, the direction of stress depends on the hydroxyl content of the ester, and, to a lesser extent, on the solvent content of the sheet when stress is applied.

Increasing hydroxyl content favours the same direction as that of the stress, whereas, as surmised by Drummond, introduction of acyl groups favours the normal direction. Thus, with cellulose acetates, the acetyl contents of which are greater than 43 per cent, the slow ray direction may be normal to the direction of stress ; similar behaviour is also shown by cellulose nitrate sheets.

Within a certain range of hydroxyl contents, in acetate and in nitrate sheets the amount of solvent or imbibed liquid when tension is applied may influence the position of the slow ray. In general, the slow ray lies normal to the direction of stress if tension is applied to a sheet which contains a large proportion of solvent, whereas removal of the latter favours its location in the direction of the applied stress.

The extrapolation of birefringence values of cellulose ester sheets to zero acetyl content by Drummond finds some justification from measurements made on uniaxial cellulose acetate sheets, where the increase in negative birefringence is approximately linear with a decrease from 44·8 to 27·0 per cent acetyl. This is more strictly the case in the triacetate region, provided a solvent is selected which gives relatively flexible sheets, and that esters of similar chain-length are employed. As might be anticipated, increase of chain-length increases the negative birefringence.

A detailed discussion of these results will be published elsewhere.

It may be opportune to emphasize here that this method of sheet birefringence determination[2] in its more accurate form is restricted to sheets of relatively low values of birefringence such as those which lie beyond the sensitivity of immersion methods. The method is essentially an approximation in two respects, first, in the assumption of identity of path of the two components in transmission through the sheet, and secondly, in the inherent approximation of the graphical extrapolation.

JOHN SPENCE.

Research Laboratories,
Eastman Kodak Company,
Rochester, N.Y. Feb. 15.

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[2] Spence, J., *J. Phys. Chem.*, 43, 865 (1939).

Structure of Cellulose Acetate

RECENTLY I have examined several samples of cast plasticized secondary cellulose acetate sheet material under the microscope. With crossed nicols a uniform yellow polarization colour was shown, indicating a considerable amount of orientation. Taking the casting flow-lines, parallel to the 'selvedge' edge, as the direction of the *c* axis, the samples showed oblique extinction. This phenomenon is consistent with the view that the cellulose acetate unit, and also the parent cellulose, is monoclinic rather than orthorhombic.

C. A. REDFARN.

Quality House, Quality Court,
Chancery Lane,
London, W.C.2. March 6.

Points from Foregoing Letters

L. Jánossy and P. Ingleby have carried out counter experiments which give evidence for the occurrence of penetrating showers distinctly different from cascades or knock-on showers. Parts of the showers may possibly be accounted for by assuming the creation of mesons in lead.

Mechanical pressure on the eye causes temporary blindness through retinal anoxæmia. K. J. W. Craik finds that after-images of a light exposed to the eye in this condition can be seen on releasing the pressure. This appears to demonstrate their retinal origin, since the stimulation from the primary image has never reached the visual centres in the brain.

In a reply by F. Dickens to a recent comment by Boyland, it is pointed out that although the association of a lowered respiratory quotient with a strong aerobic glycolysis is no longer considered as strictly specific to tumour metabolism, the occurrence among normal tissues of this combination is exceptional enough for it to remain the most characteristic of the known biochemical features of cancer. Dr. Boyland replies that, in his opinion, as this combination does recur in some cases, it is undesirable to say that tumours differ from non-malignant tissues in these properties.

Using enzyme preparations obtained from the electric organ of Torpedo, D. Nachmansohn finds that choline esterase is only active in the presence of divalent cations. Monovalent cations will reactivate the enzyme, but only at very high concentrations.

J. Spence points out, in regard to the anisotropy of cellulose sheets, that the hydroxyl content of the cellulose ester and the solvent content of the sheet influence the orientation of the slow ray in the plane of the stressed sheet. Uniaxial cellulose acetate sheets show, within limits, a linear increase in negative birefringence with increasing hydroxyl content.

RESEARCH ITEMS

Pleistocene and Prehistory in Europe and China

EXTENSIVE research by Wen-Chung Pei in the Chinese Pleistocene and comparison with corresponding results of European geologists and archæologists is summarized in "An Attempted Correlation of Quaternary Geology, Palæontology and Prehistory in Europe and China" (Institute of Archæology, University of London. Occasional Paper No. 2, 1939. Pp. 16+2 tables. 2*s*. 6*d*.). The object of the investigation was to arrive at the age of Sinanthropus, which is here assigned to the Lower Pleistocene in spite of the lithic industry, which exhibits a few features that in Europe do not appear until later. From the point of view of human evolution Sinanthropus would be contemporary with the European Eoanthropus and *Homo Heidelbergensis*. While the European Quaternary covers four main periods of cold climate, in China four physiographic cycles may be observed in which phases of erosion alternated with phases of sedimentation. From the geological point of view, Europe and China have two series of Pleistocene deposits in common, the older covering the period from late Pliocene to early Pleistocene, the younger characterized by the frequent occurrence of loessic material. These two series can be correlated in Europe and in China stratigraphically, lithologically and faunistically; but it is impossible to go further and into detail. It is premature, therefore, to base a correlation on geological evidence only. A purely palæontological basis, notwithstanding difficulties, is more satisfactory. The early Saumenian corresponds to Villafranchian, Choukoutien (Sinanthropus level) to Cromerian, Choukoutien III to early middle Pleistocene, Sjara-Osso-gol (Ordos) to Neanderthal, and Choukoutien Upper Cave to European Upper Palæolithic. Prehistory helps little, owing to differences of workmanship, but subject to this proviso, Choukoutien loc. 13 is contemporary with Abbevillian, Choukoutien loc. 15 with early Acheulean, early Clactonian and Tayacian, Ordos with middle and late Acheulean, Micoque, early and middle Levalloisian and Mousterian, and Choukoutien Upper Cave with upper Palæolithic—Aurignacian, Solutrean and Magdalenian.

Insulin Hypoglycæmia and the Central Nervous System

ERNST GELLHORN reported his investigations on the effects on the central nervous system of insulin hypoglycæmia before the recent meeting of the American Association. There is a close interrelationship between its effects and those of cerebral anoxia, in that the two states are mutually synergistic, and in both there is depressed cortical but augmented autonomic excitability. The resultant increased activity of the sympathetic system tends to restore the blood-sugar level, and at the same time to render the medullary centres less excitable, in this case by a direct action upon them of circulating adrenalin. Such reactions tend to restore the animal to its resting state, but may, under slightly different conditions, aggravate the effects of the changes. Thus, prolonged anoxia may prevent hypoglycæmic convulsions, but may also prevent the eventual restoration of a normal blood-sugar level by depressing the mobilization of the hepatic stores of glycogen.

Inheritance of Bobbed Hair

S. E. STODDARD (*J. Hered.*, 130, 543–545; 1940) reports a pedigree in man showing the inheritance as an autosomal dominant of a short fore-lock. The hairs of the fore-lock on the head of the affected individuals grow to five or six inches and then fall out, being replaced by new hairs which again reach 5½ inches and then fall out. This self-bobbing characteristic is to be called 'catatrichy'.

The Oldest Vertebrate Egg

FOSSIL reptilian eggs have been recorded from Cretaceous and Jurassic deposits, but they are rare, and the most striking discovery hitherto was the nest of dinosaur eggs found in the Desert of Gobi by Dr. Roy Chapman Andrews and his fellow-explorers. All earlier records are, however, much antedated by the discovery of an egg, 59 mm. long, at Rattlesnake Canyon, Archer Co., Texas, in rocks which lie close to the boundary between Carboniferous and Permian. Prof. Alfred S. Romer and Llewellyn I. Price describe the shell, almost 1 mm. thick, as ornamented with small rounded tubercles, and in section showing lamellæ, typical of amniote egg-shells (*Amer. J. Sci.*, 237, 826; 1939). The interior, as examined by X-ray photographs, showed no indication of embryonic development. Although it is impossible to say to what reptile the egg must be assigned, the most abundant of the four common reptiles of the Red-beds of Texas is the pelycosaur Ophiacodon (Theropleura), and the "chances are perhaps somewhat in its favor as the possible progenitor".

Growth Hormones in Seed Dressings

H. E. Croxall and L. Ogilvie (*J. Pom. and Hort. Sci.*, 17, 362; 1940) have shown that the application to pea and bean seeds of dry fungicidal dressings containing growth-promoting substances may be of considerable value. The vegetative growth of several different varieties of pea plants was stimulated by such treatments, but there was no difference in time of flowering. The dressings used consisted of talc, a proprietary mercurial dressing, and cuprous oxide, containing 5–20 parts per million of naphthalene acetic acid, mixed naphthylidene acetic acids and indolyl butyric acid. The rate of emergence of pea seeds sown in sterile soil in the greenhouse was accelerated, and the dry weight of the seedlings after three weeks growth was increased, by treating the seeds with the above dressings. In certain conditions, the development of some varieties of peas was checked by mercurial and cuprous oxide dressings. This check was partly or entirely overcome by the incorporation of growth substances. In field trials in summer, mercurial and cuprous oxide dressings alone reduced the crop when the soil was dry for a long period, but dressings containing growth substances gave yields up to 80 per cent greater than those from untreated seeds. In greenhouse soil contaminated with damping-off fungi, a higher percentage emergence from several varieties of peas, and one of dwarf beans, was obtained by treating the seeds with hormone-containing dressings than by the use of the same dressings without hormones. There was considerable difference in the response of different varieties to the dressings used.

Two Distinct Diaphorases

COENZYME-SPECIFIC dehydrogenases catalysing the oxidation of tissue metabolites such as lactic acid may require the presence of coenzyme I (diphosphopyridine nucleotide) or coenzyme II (triphosphopyridine nucleotide). Reduced coenzymes I and II do not by themselves react with oxygen, and a further link has been made by the demonstration of the presence in animal tissues of a 'coenzyme oxidase', named by Euler 'diaphorase' and by Dewan and Green 'coenzyme factor', which catalyses the oxidation of these reduced coenzymes I and II. Also, cytochromes *-a* and *-b* are rapidly reduced by the diaphorase – coenzyme system and re-oxidized by cytochrome oxidase and oxygen. The complete

thus :

-b ⟶ Oxygen

oscillograph. The results confirm those of previous workers that the electric field changes due to a lightning discharge include a slow field change due to the leader stroke, a rapid return stroke, and a final slow non-oscillating change. The disturbance is often followed by waves reflected from the ionosphere. In some cases a damped oscillating discharge was observed, and reasons are given for regarding this as a feature of the discharge rather than a result of successive reflections. A mean value of the peak power in an atmospheric is 5×10^5 kw., and of the total energy radiated 200 kw. sec. This is small compared with the total energy of a thundercloud.

An Auto-collimating Spectrohelioscope

M. A. ELLISON has described very fully a home-made spectrohelioscope (*J. Brit. Astro. Assoc.*, 50, 3 ; 1940). The instrument took Mr. Ellison 2½ years

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and those who are interested

the paper carefully. It

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INTERNATIONAL HEALTH INVESTIGATIONS

THE report to the Council of the League of Nations on the work of the thirty-first session of the Health Committee, November 20–24, 1939 (Special Supplement to Monthly Summary of the League of Nations, January, 1940), emphasizes the important duties of the Health Organisation under war-time conditions, particularly in view of the threats to health from movement of populations and evacuation.

The Committee agreed that the permanent health services should not be interrupted, particularly the Epidemiological Intelligence Service, the Singapore Bureau and the biological standardization
utility of which is universally
also desirable to contin
siderable amount of
out, such as the

water, and lower standards of living and hygiene. The Emergency Sub-Committee and the Health Section have accordingly been authorized to take such action as circumstances require, including a stocktaking of the armoury of preventive and curative weapons made possible by modern epidemiology, chemotherapy and serotherapy. The Health Section proposes to define the principles which should be followed in the control of those epidemic diseases which are regarded as the most
circumstances, for

out that any attempt to determine molecular weight of the protein by any of these means would yield abnormally large values.

In the sphere of host-virus relations, Ernest L. Spencer, of the Rockefeller Institute for Medical Research, demonstrated that the rate of virus multiplication is closely bound with the nitrogen metabolism of the host. Tobacco plants growing in pure culture, and supplied with a relatively large amount of nitrogen, allowed the virus to attain about five times the concentration found in normally fed plants. The effect was not due to an increased growth-rate of the plant, and it was also demonstrated with older seedlings. James M. Wallace, of Riverside, California, dealt with the development of resistance to the curly top virus of Turkish tobacco. *He showed that plants* recover from an attack by the virus, a certain time after inoculation. Such plants, when re-inoculated, do not again develop severe symptoms. Transmission from a recovered to a healthy plant by means of insect vectors induced severe symptoms in the healthy plants, but grafting merely transferred the mild symptoms typical of the recovered plants. Resistance, therefore, appears to be due to some interaction which is set up between host and virus.

S ASSOCIATION*

that the development or the preservation of aerial respiration in fishes of the tropical fresh waters was a response to the shortage of oxygen in the water, and that it occurred while the fish was still purely aquatic. The fish was then ready for the later changes which completed the migration. The stimulus for these was probably provided by the droughts to which any animal living in such waters must have been subjected. That this has been the course of the later stages of the migration on to the land is generally accepted, but it does not seem to have been so generally realized that the first stage in the process of migration was the evolution of adaptations to aerial respiration, first instigated by the lack of oxygen in the shallow tropical fresh waters in which the fish lived."

This presidential address in its printed form, with its extensive bibliography and liberal quotations from the work of other investigators, is to be [illegible] as a helpful handbook of reference [illegible] general biological interest.

ECOLOGY AND CO[illegible]

The basic principle underlying this method is the differential behaviour of a pest and its parasite under the same ecological conditions. This is illustrated by Shelford's work on the aphid, *Toxoptera graminum* and its parasite, *Lysiphlebus tritici*, and by the researches of several other workers. Even small differences in the rates of development of the host and parasite may cause the extinction of one or the other.

The control of malaria-transmitting mosquitoes by ecological methods has had undoubted success in certain areas and has possibilities of more general application. The fact that most of the vector Anophelines do not breed in sewage-polluted waters is exploited by turning industrial wastes, etc., into clean breeding waters. On the same [illegible]lling of pools and streams [illegible] ja, presiding over the Section of Botany, considered the peculiar group of algæ known as the Myxophyceæ. These algæ present many problems, both economic and botanical, and in spite of the extensive literature there is scarcely any authoritative statement that can be made concerning any aspect of their study at the present time. Owing to the peculiar properties of their cells, many of them are able to exist under high-temperature conditions and are largely tropical in their distribution, so that India is a particularly suitable centre for their study. With the active investigations that are being carried out by Prof. Bhâradwâja and other algologists at Madras, Lahore and Benares, it is hoped that much light will be thrown upon their peculiar features.

A special interest of this group for India is the way in which the Myxophyceæ at times undergo extreme development and give rise to the condition known as 'water-bloom'. On death and decay, such masses of algæ give disagreeable tastes and odours to the water and may render it unfit for drinking purposes, in fact there are records from many parts of the world of serious effects produced upon man and animals by drinking such water. In India, water-blooms are of common occurrence in ponds, pools and tanks, the water of which is used for consumption by humans and domesticated animals; though no serious effects have so far resulted in India, it is obviously a subject requiring investigation. Such points as the conditions favouring the development of the blooms, the contributing organisms, methods of control, and the manner in which the organisms persist all require workers in India.

Prof. Bhâradwâja also directed attention to the problems played by Myxophyceæ in soil ecology. These algæ occur in considerable numbers in the soil flora and some of them, notably Nostoc and Anabæna, are capable of nitrogen-fixation. In the Indian rice fields, the same crop is grown year after year without addition of manure, and it has been discussed whether the abundant development of these algæ during inundation may be a factor of any importance. Fritsch and De came to the conclusion that their part in this connexion was probably relatively insignificant, but the problem needs further study.

*Continued from page 471.

[illegible] many cases the generic distinctions are unsatisfactory, as they are not applied logically and allow of too much intergrading. Their cytology has received considerable attention lately and most workers are now agreed that the central body may be regarded as a nucleus.

Systematic study of the group involves such problems as their relation to the isolated group of the Chamæsiphonales and also to the Bacteria, especially such types as the sulphur bacteria.

Prof. Bhâradwâja's address points out the wide scope for workers in this field, and his survey of the present position of knowledge of the group will be a valuable basis for anyone attracted to further the study of the Myxophyceæ.

AIR-BREATHING FISHES

The presidential address to the Section of Zoology was delivered by Prof. B. K. Das.

In a comprehensive survey of present knowledge of the phenomenon of 'air-breathing' in fishes, Prof. Das developed the theory of structural adaptation in response to environmental change. "The habit of swallowing air," he says, "being long continued, becomes deeply engrained in the constitution of the species, generations after generations, and is gradually improved and eventually leads to structural modifications, usually in the form of reservoirs adapted to lodge the inhaled air. These reservoirs are of very different forms and quite independently evolved, in each and every species of fish. . . ."

Six main types were described of progressive adaptations, which are to be seen in modern air-breathing fishes, namely, modifications of the buccopharynx; pharyngeal 'lung'; opercular chambers; opercular 'lung'; specialized parts of the alimentary canal (stomach and intestine); and the air-bladder. These accessory respiratory organs are regarded as the physiological forerunners of the true lungs of the terrestrial vertebrates, evolved in consequence of a lack of oxygen in the water.

The views of Carter and Beadle are supported and quoted verbatim: ". . . A power of breathing air must have been a necessary preliminary to the possibility of migration to land. It appears probable to the Section of Entomology, discussed the general principles of insect ecology and, in particular, the application of such knowledge to insect control. As he pointed out, if we know the conditions of environment of an insect pest and the influence of changes thereof on its population, it may be possible to predict the outbreak of the pest in advance or to evolve methods which would keep the injurious species under control. Of the various physical factors of environment, temperature is undoubtedly the most important single agency. In order to illustrate the influence of this factor and to indicate how such information can be utilized by applied entomologists, examples are given of Zwolfer's critical work on the nun moth, *Lymantra monacha*, of Bodenheimer's studies on the Mediterranean fruit-fly and of several other works.

Next in importance to heat, the fundamental necessity of insects, as of other animals, is the moisture content of their environment. Too low or too high humidity is injurious to their existence. On the basis of such information, the Imperial Agricultural Research Institute has shown that good and well-spread rains do not reduce the spotted boll worms of cotton directly, but indirectly by raising the atmospheric humidity, which is inimical to the bollworm and conducive to the multiplication of its parasite *Microbracon lefroyi*. Afzal Husain and Haroon Khan's work on the ecology of pink bollworm of cotton in the Punjab illustrates the combined effect of temperature and humidity on insect prevalence. They found that temperatures between about 18° C. and 26° C., with a relative humidity of more than 70 per cent, are most suitable for egg production and oviposition. Those parts of the Punjab where temperature and humidity conditions approach the above figures during July–October, which is the active period of the pest, are badly infested with the bollworm, while in canal colonies and the western Punjab, where the conditions are different, the pink bollworm does not occur as a pest.

Insects are not only exposed to climatic factors but also to biotic factors such as parasites, predators, competitors, types of surrounding vegetation, etc. The importance of natural enemies in reducing the population of insect pests is well known and is being exploited by workers on biological control of pests.

once appears and begins to [redacted] of streams by growing low hedges of lantana, etc., is being extensively practised in India, Malaya and other countries. These observations also emphasize the necessity of preserving original shade and adding more trees to natural jungle as an anti-malaria measure.

Dr. Pruthi's address, it may be added, is well documented with a bibliography of the literature bearing upon the subjects under discussion.

ANTHROPOLOGICAL AND ARCHÆOLOGICAL STUDIES IN INDIA

The presidential address to the Section of Anthropology was delivered by Rao Bahadur K. N. Dikshit, who discussed "The Scope of Prehistoric and Anthropological Work in India".

It is to be hoped that the association between archæology and anthropology which has been exemplified in this session of the Indian Science Congress will be a more abiding one, and will react to the mutual advantage of both the sciences, and that all universities and research institutions, which have provided facilities for work in one, will always extend them to the other branch of humanistic studies. In this vast country there is unlimited scope for these studies, and the danger from the extension of cultivation and rural expansion in a more sophisticated mode of life is equally felt by both. It is, therefore, all the more necessary that the future research programme should be speeded up and properly co-ordinated.

So far as expenditure is concerned, although archæology looms somewhat large among the scientific departments of the Government of India, an infinitesimal amount is available for expenditure on work of a scientific character. The personnel ought to be strengthened with a view to the extension of scientific activities in prehistoric archæology and anthropology. Many of the museums are doing good work in the educational sphere, but there is scarcely any scope for the acquisition of scientific knowledge regarding man and very few research facilities.

Sir Leonard Woolley has directed attention to the want of sufficient contact between the Archæological Department and the anthropologist. He has

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INTERNATIONAL UNITY IN WAR AND PEACE

THE solemn declaration of the Supreme War Council issued in London last week states firmly and explicitly what most people have taken for granted about the unity of the Allies in war and in the making of peace. It should now be clear to the whole world that their unity is firmly established, and that it is not merely a contribution towards winning the war but will also constitute the sure and stable foundation of an enduring peace. The two Governments, desiring to extend the scope of agreements concluded last December to all spheres affecting the interests and security of the two nations, mutually undertake that they will neither negotiate nor conclude an armistice or treaty of peace except by mutual agreement, and that they will not discuss peace terms before reaching complete agreement on the conditions necessary to ensure to each of them an effective and lasting guarantee of their security.

The final declaration is even more significant. The two Governments undertake to maintain, after the signing of peace, a community of action in all spheres for so long as may be necessary to safeguard their security, and to effect the reconstruction, with the assistance of other nations, of an international order which will ensure the liberty of peoples, respect for law and the maintenance of peace in Europe. The terms of this declaration are strikingly in harmony with the recent declaration of President Roosevelt, and on that ground alone are reassuring to neutral as well as Allied, opinion and likely to promote Anglo-American understanding and good relations. More important still, confirming Sir John Simon's statement in a recent broadcast that the close Anglo-French co-operation established in every field will continue when the War has ended, it encourages the hopes which have been placed in Anglo-French co-operation as a stepping-stone to a new world order.

The declaration is open to no other interpretation than that the two Governments have accepted the responsibility for a further task when their joint forces have won for them security and the guarantee that it will endure—the organization of a new international order, capable of preserving law, liberty and peace for all nations. Already the co-operation between the two nations in the prosecution of the War itself has led them to give up their absolute sovereignty. That part of their sovereignty which they have surrendered into the common fund of authority is now to remain there at least until the new international order has been established.

This declaration, therefore, amply justifies the hopes of those who saw in the Supreme Council and the Allied High Command the germ from which might develop an international organ of government with an international police force at its command. In the light of it, again, arrangements recently concluded between the British and French Colonial Offices for pooling information and advice on problems of government in Africa may well form the basis for an extension or evolution of the mandates system, which may provide the world with an adequate and just settlement of the problems of colonies and access to raw materials. Similarly, the experience gained in the working of the economic and financial agreements will be of incalculable value.

This declaration justifies the strongest hopes of those who are concerned with the establishment of a new and enduring world order which will safeguard the liberty of peoples and respect for law, on which human progress in whatever field has been based, and indicates that, when the time comes to discuss larger systems of co-operation, Anglo-French collaboration will provide us with an invaluable store of wisdom on the community of ideas necessary for co-operation to be possible, and on the ends to which co-operation is desirable and possible. Already it shows us that some of the gravest weaknesses of the Treaty of Versailles and of the Covenant of the League of Nations will be avoided. The framework or constitution of the new world order will be attempted by a separate and subsequent act to the framing of the terms of peace. The declaration of March 28 may well come to assume historic significance in the evolution of world order, both as marking a stage towards the renunciation of absolute national sovereignty and in the linking of the distinctive political genius of two entire peoples in building up a system of co-operation to serve their own immediate purposes and also those of all other States subscribing to like ideals of law and justice, of freedom and humanity.

EDUCATION IN THE ARMED FORCES

IN his review in the House of Commons on March 13, the Minister of War directed attention to developments in the provision of educational facilities for men in the Armed Forces. Mr. Stanley outlined the general scheme which is in operation under the ægis of the Central Advisory Council for Adult Education in H.M. Forces (Home Services), which was brought into being a few months ago. The Council is representative of organizations for adult education, and works in conjunction with regional committees set up by the vice-chancellors of universities or principals of university colleges in their own areas. The Board of Education acts as the medium through which the Central Advisory Council makes contact with the Admiralty, War Office, and Air Ministry, while the divisional inspectors of the Board take a similar part with the regional committees. The Central Advisory Council had appealed to the War Office for a sum of £10,000 "to be going on with", and help on a similar scale is being requested from the Admiralty and Air Ministry. The outcome of these applications is not clear and was not dwelt upon by Mr. Stanley in his statement, although the omission suggests that the applications have been at least temporarily shelved. It is essential that the existing situation should be clarified if misconceptions are to be avoided.

At its initial meeting, adequate testimony was reported by the Central Advisory Council to show that men and women in the Services are in pressing need of educational facilities of all kinds, including lectures and discussions, books and correspondence, and other services that have been fostered by adult education associations. The need of men and women in the Services for mental stimulation as well as for welfare and recreational facilities has frequently been neglected, a danger of which full cognizance must be taken to-day. This was not generally realized until the closing stages of the War of 1914–18, and not until 1920 was the Army Educational Corps founded as a permanent organization.

The objects of educational services were stated in an Army Order of September 24, 1918, to be: (*a*) to raise morale by indirectly providing mental stimulus and change, and directly by means of lectures on German methods, guns, etc.; (*b*) to broaden and quicken intelligence both by stimulating a desire for study and by giving men a wider realization of their duties as citizens of the British Empire; (*c*) to help men in their work after the War by practical instruction, so far as may be possible, in their professions or trades. When later the various educational schemes were introduced, they were eminently successful; their earlier introduction might have prevented much of the confusion that followed demobilization. Since that time, adult education has made such great strides that many men and women of the Forces to-day have been accustomed to lectures and discussions. The adoption of adequate educational measures is a matter of urgency, and one which should, if carefully planned, lead to the extension of democratic principles in a way which previously has been impossible.

The types of lectures that are likely to be most popular for men and women in the Forces have already been carefully investigated. The early experiments of the Central Advisory Council showed that the needs of the Services fall into three main groups: (1) a great demand for single lectures by authorities on such subjects as foreign affairs, history, exploration, literature suggested the possibility of unravelling the problems of the past by significant survivals among existing peoples, as, for example, the ancient burial customs in South India. A common plan pursued by workers in the field should, he holds, result in a more intelligent collection of anthropological material, and the task of the archæologist would be made simpler if the museums of India were to collect and preserve, not only ancient pottery and handiwork, but also that produced up to to-day by the primitive peoples of India. The idea of a central ethnological museum in New Delhi unfortunately has been allowed to lapse, and India is still without either an anthropological, ethnological or archæological central museum.

Turning to the field of prehistoric archæology, it is now more than seventy years ago that the first human artefacts associated with the bones of extinct mammals were found in the cliffs of the Nerbada and the Godaveri. It is unfortunate that further investigations were not carried on in the light of new discoveries in every part of the world. The attention of the Government and the universities should be directed towards the necessity of the systematic conduct of such work under trained prehistorians. It is unfortunate that the systematic survey of the Yale-Cambridge expedition under Dr. H. de Terra has not been continued.

The most interesting and well-developed phase of the prehistoric civilization of India undoubtedly is that represented by Harappa and Mohenjo-daro. It is unfortunate that there is no prospect of further work in this field to discover tribes with earlier and later cultures. Further systematic work at Dambbuthi would be rewarded with rich results unravelling an earlier civilization than Mohenjo-daro, whereas bridging the gap between Mohenjo-daro and later civilizations will occupy generations of workers.

The problem of Aryan invasion has as yet received no light from excavation in Sind and the Punjab, while the proper study of the sequence of metallurgical knowledge has yet to be established, and the place of the copper culture of the Gangetic valley and the iron industry of, for example, Bellary in the south has yet to be determined. Further research alone will show what the exact relation between the stone and metal ages of North and South India must have been.

In South India, the scope for work is greater owing to the abundance of material suitable for the manufacture of tools for palæolithic and neolithic man; while in every district one or other phase of pre- and protohistory is present in examples which must be systematically studied before many of them meet destruction at the hand of man. Among such subjects of research are the rock-shelters and the rock-paintings and carvings which lead up to the culminating splendours of Ajanta and Bagh.

One of the greatest difficulties facing the physical anthropologist in India is that of obtaining material for determining the racial characteristics of the ancient people of their country. The dearth of students in this highly interesting branch of knowledge is very keenly felt. In anthropometry, much interesting work has been done in the various provinces and among the different castes or tribes; but it is no exaggeration to say that barely the fringe of the problem has been touched. For the anthropologist there can be no more interesting country than India to study, although he would probably be overwhelmed by the immensity of the task and the diversity of the material before him. When in India every stage of the entire progress of the human race from the humblest beginnings to the greatest spiritual elevation can be studied with greater ease and facility than in any other country, is it too much to expect that the proud possessors of this wonderful heritage will not neglect their patrimony and will not leave entirely to others the task of studying themselves, their racial composition and age-long cultures ?

CROP PRODUCTION IN INDIA

The presidential address to the Section of Agriculture was delivered by Prof. Jai Chand Luthra, who took as his subject "Some Problems of Crop Production in India". Prof. Luthra began by reviewing the condition of Indian agriculture up to the time when the Government took steps to organize some aspects of it on scientific lines, that is about the beginning of the present century. He stressed the fact that India's farm produce is meant primarily for local consumption, and agriculture must therefore remain India's basic industry; there is, however, a demand for the establishment of secondary industries, such as those processing grain for breakfast food.

In the nineteenth century agriculture suffered a setback, of which the chief cause was the indifference of the farmer to the quality of seed. This neglect is of comparatively recent date, for at one time India was famous for the fine quality of its cotton. The merit and the constitutional structure of seed is of fundamental importance in crop husbandry. In India there is no legal safeguard of germination percentage, and pressing need is felt for a Seeds Act. Prof. Luthra reviewed some factors bearing on seed quality. Experiments at Lyallpur have shown that a predominance of yellow in the seed of berseem is an indication of maturity and of good germination; and the proportion of yellow seed bears an inverse relation to the number of cuttings taken from the crop left to seed. A similar correlation of colour to viability has been observed in seeds of shaftal (*Trifolium resupinatum*) and of lucerne.

Selection and breeding have done a great deal for Indian agriculture, but have brought about peculiar difficulties. One of the most important crops of the Punjab and the United Provinces is gram (*Cicer arietinum*). When the two best gram selections, evolved after twenty-five years work, were introduced into cultivation, blight disease was confined to the northern part of the Punjab. For the last four years, gram in other parts of the province has been stricken so severely by blight that one popular selection has been affected up to at least 50 per cent. The growers get alarmed when they find crops damaged by unaccustomed diseases, and it is no wonder if the growers remark that agricultural departments create the diseases. However, in Burma the serious wilt of gram has been overcome by the discovery of a resistant type that now occupies the entire area under that crop.

The wealth of India lies in its innumerable villages; as Tagore has said, "In the keeping of the village lies the cradle of the race". For effecting real improvement in agriculture, it is necessary to take stock of the economic conditions of the farmer. The village is working under many disabilities. There is everywhere an earnest desire that the farmer should raise his standard of living, but so long as he is unable to increase his earning power this will remain a wish. Some measures are necessary for affording relief to the growers of food crops. In the Punjab the average size of a cultivated holding is scarcely 10 acres, and as many as six or seven persons live on it. Considerable labour is therefore being wasted on an unremunerative occupation.

NUTRITIVE VALUE OF RICE

Dr. W. R. Aykroyd devoted his presidential address to the Section of Physiology to the subject of rice. Rice is the staple food of the majority of the population in the provinces of Assam, Bengal, Bihar, Orissa and Madras. The diet of many other peoples in the East is also based on rice; in fact, it is stated that rice is the staple food of about half the human race. Yet, by modern standards, the rice-eater's diet falls short of such standards in almost every important constituent. In India he consumes in addition to his staple cereal, which supplies 80–90 per cent of the total calories, only very small quantities of other foods such as pulses, vegetables, fruits and meat; milk and milk products are taken in negligible quantities or not at all.

Rice, compared with most cereals, has a low protein content, although the proteins are of high biological value. It is poor in fat and carotene, calcium and iron; the amount of phosphorus present is fairly high. Milling reduces all the above constituents; in many parts of India, however, rice is prepared for consumption by hand-pounding, when the losses are less. Hand-pounded rice retains 50–75 per cent of the pericarp, the germ being usually completely removed. Raw rice when milled loses about three-quarters of its vitamin B_1 and two thirds of its nicotinic acid; these losses are considerably reduced if the rice is parboiled first. Parboiling is the steaming or boiling of unhusked rice after soaking; this splits the woody husk and renders its subsequent removal easier. After parboiling, the rice is pounded or milled in the same way as raw rice; during the steaming some of the vitamin B_1 and nicotinic acid diffuses through the grain and cannot be removed by subsequent milling. This fact is of great importance and, since most of the rice-eaters in India consume parboiled in preference to raw rice, explains the relative rarity of typical beriberi in most parts of the country. Washing the rice results in further losses of essential foodstuffs. The losses are of the following order: calories, 15 per cent; protein, 10 per cent; iron, 75 per cent; calcium and phosphorus, 50 per cent; vitamin B_1 and nicotinic acid, 40–50 per cent.

Dr. Aykroyd finally considered how rice diets can be improved. He is of the opinion that the development of strains of high nutritive value is unlikely to improve rice diets, since rice will always be deficient in certain food factors. He considers the easiest way of raising the nutritive value to be by minimizing the losses brought about by milling, washing and cooking. On the other hand, the introduction of high-yielding strains will reduce the pressure on the land and enable the production of supplementary foods to be increased. When parboiled rice is consumed, there is little difference in nutritive value between hand-pounded and machine-milled, although the former is to be preferred. Highly milled raw rice is a danger to public health, and its use should be discouraged. Dr. Aykroyd suggested that milling beyond a certain degree should be prohibited; a suitable standard might be not less than 1·5 μgm. of vitamin B_1 per gm. Once-polished raw rice has a vitamin B_1 content of this order; use of such a rice would prevent the appearance of beriberi.

Rice must, however, be supplemented by other foodstuffs. Dr. Aykroyd suggested that ragi, a millet, should substitute rice in part, and that the intake of pulses and green leafy vegetables should be increased; the latter supply vitamin A and calcium. Milk is the best supplement to rice diets; if fresh milk is not available, milk reconstituted from skimmed milk powder may be recommended. Milk supplies calcium, or this element can be provided in the form of calcium lactate; such a supplement (about one gram daily) definitely improves the state of nutrition of children on a rice diet. Vitamin A can be provided in green leafy vegetables, milk-fat, fish liver oil or red palm oil. Dr. Aykroyd suggested that it might be possible to blend the latter with common Indian vegetable oils to produce a palatable product with a vitamin A activity corresponding to that of good butter. Finally, he emphasized that the development of an efficient fishing industry would provide India with a valuable supplement to poor rice diets.

PSYCHOLOGY AND EDUCATIONAL RESEARCH

In his presidential address to the Section of Psychology, Dr. D. D. Shendarkar said that although psychology is a comparatively young science, yet it has already found application in many fields, of which education is of vital importance. Results of investigations into such educational problems as scholastic and intelligence tests, examinations, and learning processes, are evidence of the value of psychological methods and knowledge to the efficiency of the teacher. Education is becoming more scientific in method. The suggestion, though, of practical problems and the testing of the experimental results in actual practice must rest with the teacher. Unfortunately, the psychology taught in training colleges for teachers is often too theoretical, and the young teacher does not see the connexion between the science and the problems of the class-room.

There is an urgent need for a central institute of education where training in research methods could be obtained, and where modern research sources in educational topics would be available for reference. Such a body would serve both as a training and consultative body as well as a centre for research. Although learning is the central problem in education, yet research into the learning processes is inadequate, largely because experiments in learning have been studied in psychological laboratories, and the materials employed have too often been of an artificial nature. Research into testing for intelligence has yielded practical results, and now intelligence tests are used in selection for admission to different types of schools, for vocational guidance, and for diagnosing feeblemindedness and backwardness. The problem of admission to different types of higher secondary schools is in reality one of discovering the type of education most suited to the capacities and interests of the pupils, so that they may be classified according to mental ability rather than according to scholastic attainments. Little, however, is known of the abilities required for the various vocations.

Psychology has made considerable development in regard to children's problems and child guidance, and it attempts to diagnose and treat the underlying causes of the various symptoms instead of dealing with the symptom alone. The utilitarian study of psychology has not, however, kept pace with its academic study; what India needs at the present juncture is that the knowledge available should be applied.

SEVENTY YEARS AGO

NATURE, vol. 1, March 31, 1870

The Size of Atoms

"The idea of an atom has been so constantly associated with incredible assumptions of infinite strength, absolute rigidity, mystical actions at a distance, and indivisibility, that chemists and many other reasonable naturalists of modern times, losing all patience with it, have dismissed it to the realms of metaphysics, and made it smaller than 'anything we can conceive'." "W.T." then goes on to review the experimental evidence for giving tangible sizes to atoms. He refers to Cauchy's mathematical work, and to investigations on the contact electricity of metals on capillary attraction as shown by soap bubble investigations, on the kinetic theory of gases, and sums up as follows:

"The four lines of argument which I have now indicated, lead all to substantially the same estimate of the dimensions of molecular structure. Jointly they establish with what we cannot but regard as a very high degree of probability the conclusion that in any ordinary liquid, transparent solid, or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred-millionth, and greater than the two thousand-millionth of a centimetre.

"To form some conception of the degree of coarse-grainedness indicated by this conclusion, imagine a raindrop, or a globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be coarser grained than a heap of small shot, but probably less coarse grained than a heap of cricket-balls."

Bacterial Warfare

Prof. Tyndall will have much to answer for in the results that may be expected from the spread of his "dust and disease" theory. It is stated by the *Athenæum* that a new idea has been broached in a recent lecture by Mr. Bloxam, the lecturer on chemistry to the department of artillery studies. He suggests that the committee on explosives, abandoning gun cotton, should collect the germs of small-pox and similar malignant diseases, in cotton or other dust-collecting substances, and load shells with them. We should then hear of an enemy dislodged from his position by a volley of typhus, or a few rounds of Asiatic cholera. We shall expect to receive the particulars of a new "Sale of Poisons" Act, imposing the strictest regulations on the sale by chemists of packets of "cholera germs" or "small-pox seed". Probably none will be allowed to be sold without bearing the stamp of the Royal Institution, certifying that they have been examined by the microscope and are warranted to be the genuine article.

A course of lectures for women in the science and practice of music, by Mr. Sullivan, will be delivered at South Kensington, under the patronage of the Science and Art Department, shortly after the close of Prof. Oliver's course on botany.

In speaking of the extinction of species and the struggle for existence, Mr. Darwin uses language which may be literally applied—applied without even verbal modification—to the phenomenon of languages. [From an article by Dean Farrar.]

UNIVERSITY EVENTS

London.—The title of reader in physics in the University has been conferred on Dr. F. C. Chalklin, in respect of the post held by him at University College.

The degree of D.Sc. has been conferred on Mr. Hugh Davson (University College), Mr. J. L. D'Silva (King's College), Dr. W. H. Newton (University College), Prof. Gilbert Stead (Guy's Hospital Medical School), Mr. Albert Wassermann (University College), and that of D.Sc. (Engineering) on Mr. R. H. Barfield (Imperial College).

Manchester.—Dr. C. W. Wardlaw, officer-in-charge of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, has been appointed Barker professor of cryptogamic botany in succession to Prof. W. H. Lang, who retires at the end of the present session.

Reading.—Dr. Barbara Colson, formerly research assistant in botany in the University of Manchester, has been appointed lecturer in botany.

FORTHCOMING EVENTS

Saturday, March 30

Royal Photographic Society, at 3 p.m.—H. Mills Cartwright: "Colour Photogravure by the Masking Method".

Tuesday, April 2

Royal Horticultural Society, at 3 p.m.—Prof. F. E. Weiss: "Graft Hybrids and Chimæras" (Masters Memorial Lectures. Succeeding lecture on April 16).

Thursday, April 4

Chemical Society, at 2.30 p.m.—Annual General Meeting. At 3 p.m.—Sir Robert Robinson: "Some Biological Aspects of Organic Chemistry, (a) Recent Progress in Chemotherapy, (b) Structural Relations in the Sterol Group" (Presidential Address). At 5 p.m.—Prof. E. K. Rideal: "The Sörensen Memorial Lecture".

Friday, April 5

Institution of Chemical Engineers (Eighteenth Annual Corporate Meeting, at the Hotel Victoria), at 11.45 a.m.—F. Heron Rogers: "Oil" (Presidential Address).

British Psychological Society (Extended General Meeting), April 5–6.

April 5.—Discussion on the Problems of Evacuated Children (Speakers: E. M. Bartlett, A. H. Bowley, C. Preston Rawson).

April 6.—Discussion on Propaganda (Rex Knight: "The Technique of Propaganda"; F. M. Austin: "Propaganda and Suggestion").

April 6.—Discussion on So-called War Neuroses (Speakers: Millais Culpin, T. A. Ross, Edward Glover).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Lecturer in Mechanical Engineering at the Bradford Technical College—The Director of Education, Town Hall, Bradford (April 6).

Graduate Teacher of Mechanical Engineering Subjects in the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (April 8).

Chemist in the Waterworks Department—The Secretary, Waterworks Offices, Town Hall, Manchester 2 (April 15).

Professor of Chemistry—The Principal, Heriot-Watt College, Edinburgh (April 16).

Head of the Matriculation Department—The Director of Education, The Polytechnic, 309 Regent Street, W.1 (April 16).

Temporary Lecturer in charge of the Department of Physics—The Registrar, University College, Leicester (April 17).

AN ASSISTANT MASTER to teach Geography, Mathematics, Elementary Science and Woodwork at the Rosario English School, Argentine —The British Council, 3 Hanover Street, W.1 (quoting 'Rosario') (April 17).

PRINCIPAL OF THE CEYLON UNIVERSITY COLLEGE—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

TEMPORARY FULL-TIME TEACHER OF ENGINEERING SUBJECTS—The Principal, Technical Institute, Ladywell, Dover.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

ASSISTANT TOWN ENGINEER for the Kumasi Public Health Board, Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/8332).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 19: The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 2. By Dr. T. J. Nolan and Dr. J. Keane. Pp. 199–210. 1*s*. Vol. 22 (N.S.), No. 20: Further Experiments on Transpiration into a Saturated Atmosphere. By Prof. Henry H. Dixon and J. S. Barlee. Pp. 211–222 + plate 5. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [292

West India Royal Commission, 1938–39. Recommendations. (Cmd. 6174.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net. [292

Statement of Policy on Colonial Development and Welfare. (Cmd. 6175.) Pp. 8. (London: H.M. Stationery Office.) 2*d*. net. [292

Liverpool Observatory and Tidal Institute. Annual Report, 1939. Pp. 14. (Liverpool: Liverpool Observatory.) [13

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 569, Vol. 230: Studies on the Reproduction of the Dogfish. By Dr. H. Metten. Pp. 217–238 + plate 20. 5*s*. No. 570, Vol. 230: Studies of the Post-Glacial History of British Vegetation. 3: Fenland Pollen Diagrams; 4: Post-Glacial Changes of Relative Land- and Sea-Level in the English Fenland. By Dr. H. Godwin. Pp. 239–304 + plate 21. 10*s*. 6*d*. (London: Cambridge University Press.) [63

Ministry of Health. Memorandum on Cerebro-Spinal Fever. (Memo. 234 Med.) Pp. 10. (London: H.M. Stationery Office.) 2*d*. net. [73

The Physical Society. Reports on Progress in Physics. Vol. 6. General Editor: J. H. Awbery. Pp. v + 434. (London: Physical Society.) 22*s*. 6*d*. net. [73

International Tin Research and Development Council. Fourth General Report 1939. (Publication No. 95.) Pp. 24. (Greenford: International Tin Research and Development Council.) [83

Metropolitan Water Board. Thirty-third Annual Report on the Results of the Bacteriological, Chemical and Biological Examination of the London Waters for the Twelve Months ended 31st December 1938. By Lt.-Col. E. F. W. Mackenzie. Pp. 118. (London: P. S. King and Son, Ltd.) 10*s*. 6*d*. [123

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 715: Keys to the Parasites of the Hessian Fly based on Remains left in the Host Puparium. By C. C. Hill and J. S. Pinckney. Pp. 24. (Washington, D.C.: Government Printing Office.) 10 cents. [292

Sveriges Geologiska Undersökning. Ser. C, No. 424: Geology and Ores of the Målanäs District, Västerbotten, Sweden. By Sven Gavelin. Pp. 221 + 38 plates. 5.00 kr. Ser. C, No. 425: Hydrogeographische Beobachtungen an einigen Seen in südwest-Schweden. Von Bengt Collini. Pp. 37. 1.00 kr. Ser. C, No. 426: Urbergsgeologische Undersökningar inom norrbottens Län. Av Olof H. Ödman. Pp. 100 + 16 plates. 3.00 kr. Ser. C, No. 427: Some Graphs on the Calculation of Geological Age. By Frans E. Wickman. Pp. 8 + 1 plate. 0.50 kr. Ser. C., No. 428: Lönnfallet, Southernmost Part of the Export Field at Grängesberg. By Ragnar Looström. Pp. 30 + 3 plates. 2.00 kr. Ser. C, No. 429: Kvartärgeologiska iakttagelser inom östra Storsjöområdet i Jämtland. Av Per Thorslund. Pp. 15. 0.50 kr. Ser. C, No. 430: Some Post-Silurian Dykes in Scania and Problems Suggested by Them. By Sven Hjelmquist. Pp. 32 (8 plates). 1.00 kr. (Stockholm: P. A. Norstedt and Söner.) [13

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1938. Pp. iv + 60. (Calcutta: Government of India Press.) [53

A Manual of the Liverworts of West Virginia. By Nelle Ammons. (Reprinted from *The American Midland Naturalist*, Vol. 23, No. 1.) Pp. 164 (26 plates). (Notre Dame, Ind.: University Press.) [53

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 91: The Effect of Spacing and Time of Sowing on Yield and Yield Components of Wheat Varieties. By H. Fairfield Smith. Pp. 24. (Melbourne: Government Printer.) [53

Imperial College of Tropical Agriculture. Report of the Governing Body and the Principal's Report to December 31, 1939. Pp. 32. (Trinidad and London: Imperial College of Tropical Agriculture.) [53

University of Sydney Publications in Geography. No. 3: Rain Run-off Dispersion and Soil Conservation. By Macdonald Holmes and W. H. Maze. Pp. 32. (Sydney: University of Sydney.) 2*s*. 6*d*. [63

The International Relief Union: its Origin, Aims, Means and Future. By Camille Gorgé. Pp. 52. (Geneva: International Relief Union.) [63

Association de Géodésie de l'Union Géodésique et Géophysique Internationale. Bibliographie géodésique internationale, Tome 2: Années 1931, 1932, 1933, 1934. Publié sous la direction de Georges Perrier par A. Carrier et P. Tardi. Pp. A64 + 423. (Paris: Association de Géodésie.) 200 francs. [63

The Geological, Mining and Metallurgical Society of India. Bulletin No. 3: The Uses and Applications of Sheet and Waste Mica. By Ramani Ranjan Chowdhury. Pp. 20. (Calcutta: Geological, Mining and Metallurgical Society of India.) 2 rupees. [63

Panjab University Botanical Publications. Ferns of Mussoorie. By Pran Nath Mehra. Pp. vi + 30 + 1 plate. (Lahore: University of the Panjab.) 1 rupee. [63

Department of Agriculture: Straits Settlements and Federated Malay States. Reports of the Field Branch for the Year 1938. Pp. ii + 162. (Kuala Lumpur: Department of Agriculture.) [63

Herbertia. Vol. 6, Dedicated to the Union of South Africa. Edited by Hamilton P. Traub. Pp. 252. (Orlando, Fla.: American Amaryllis Society.) 3.25 dollars. [63

National Geographic Society Contributed Technical Papers. Mexican Archaeology Series, Vol. 1, No. 1: An Initial Series from Tres Zapotes, Vera Cruz, Mexico. By M. W. Stirling. Pp. 16. (Washington, D.C.: National Geographic Society.) [63

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission G. F. de Witte (1933–1935). Fasc. 1: Introduction. Par G. F. de Witte. Pp. 40 + 33 plates. 120 francs. Fasc. 2: Myriopodes. Par C. Attems. Pp. 22. 21 francs. Fasc. 3: Oligochäten. Von W. Michaelsen. Pp. 16. 12 francs. Fasc. 4: Parasitic Nematoda. By J. H. Schuurmans Stekhoven, Jr. Pp. 40. 16 francs. Fasc. 5: Carabidae, par L. Burgeon; Carabidae (Scaritini), von M. Bänninger. Pp. 21 + 1 plate. 16 francs. Fasc. 6: Lucanidae. Par L. Burgeon. Pp. 6 + 1 plate. 28 francs. Fasc. 7: Scarabaeidae S. Fam. Cetoniinae. Par L. Burgeon. Pp. 16 + 1 plate. 61 francs. Fasc. 8: Brenthidae und Lycidae. Von R. Kleine. Pp. 18. 19 francs. Fasc. 9: Oiseaux. Par H. Schouteden. Pp. 197 + 12 plates. 150 francs. Fasc. 10: Mammifères. Par S. Frechkop. Pp. 103 + 20 plates. 150 francs. Fasc. 11: Vespides solitaires et sociaux. Par L. Bequaert. Pp. 10. 10 francs. Fasc. 12: Onitini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 18 + 1 plate. 25 francs. Fasc. 13: Haliplidae und Dytiscidae. Von L. Gschwendtner. Pp. 22. 27 francs. Fasc. 14: Pterophoridae, Tortricina and Tineina. By E. Meyrick. Pp. 28 + 3 plates. 45 francs. Fasc. 15: Passalidae. Par C. Moreira. Pp. 10 + 2 plates. 30 francs. Fasc. 16: Tardigraden. Von R. J. H. Teunissen. Pp. 21. 19 francs. Fasc. 17: Dermaptera. By W. D. Hincks. Pp. 16. 13 francs. Fasc. 18: Blattids. By R. Hanitsch. Pp. 26. 25 francs. Fasc. 19: Gyrinidae. Von G. Ochs. Pp. 22. 16 francs. Fasc. 20: Geometridae (Lep. Het.). Par H. Debauche. Pp. 56 + 6 plates. 75 francs. Fasc. 21: Scarabaeini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 76 + 3 plates. 70 francs. Fasc. 22: Nématodes libres terrestres. Par J. H. Schuurmans Stekhoven et R. J. H. Teunissen. Pp. 229 + 13 plates. 275 francs. Fasc. 23: Curculionidae (S. Fam. Apionidae). Par L. Burgeon. Pp. 21. 16 francs. Fasc. 24: Poissons. Par M. Poll. Pp. 81 + 11 plates. 108 francs. Fasc. 25: Oniticellini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 22 + 1 plate. 16 francs. Fasc. 26: Histeridae. Par L. Burgeon. Pp. 18. 20 francs. Fasc. 27: Arthropoda, Hexapoda—1. Orthoptera: Mantidae, par M. Beier; 2. Gryllidae, par L. Chopard; 3. Coleoptera: Cicindelidae, par W. Horn; 4. Rutelinae, par F. Ohaus; 5. Heteroceridae, par R. Mamitza; 6. Prioninae, par A. Lameere; Arachnoidea: 7. Opiliones, par C. Fr. Roewer. Pp. 29. 25 francs. Fasc. 28: Curculionidae. Par A. Hustache. Pp. 50. n.p. Fasc. 29: Coprini (Coleoptera Lamellicornia Fam. Scarabaeidae). Par A. Janssens. Pp. 104 + 4 plates. n.p. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission H. Damas (1935–1936). Fasc. 1: Recherches hydrobiologiques dans les Lacs Kivu, Édouard et Ndalaga. Par H. Damas. Pp. 128 + 9 plates. 135 francs. Fasc. 2: Spongilliden. Von W. Arndt. Pp. 26. 20 francs. Fasc. 3: Copépodes Harpacticoïdes. Par P. A. Chappius. Pp. 19. 20 francs. Fasc. 4: Moerisia Alberti nov. sp. (Hydropolype dulcicole). Par E. Leloup. Pp. 7. 9 francs. Fasc. 5: Rotifères. Par P. de Beauchamp. Pp. 11. 12 francs. Fasc. 6: Poissons. Par M. Poll avec la collaboration de H. Damas. Pp. 73 + 9 plates. 130 francs. Fasc. 7: Cladocera. Von V. Brehm. Pp. 12. n.p. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Exploration du Parc National Albert: Mission P. Schumacher (1933–1936). Fasc. 2: Anthropometrische Aufnahmen bei den Kivu-Pygmäen. Von P. Schumacher. Pp. 69 + 26 plates. 154 francs. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Institut des Parcs Nationaux du Congo Belge. Contribution à l'étude de la morphologie du vulcan Nyamuragira. Par R. Hoier. Pp. 20 + 16 plates. 79 francs. (Bruxelles: Institut des Parcs Nationaux du Congo Belge.) [73

Department of Agriculture, Canada. Annual Report of the Forest Insect Survey, Division of Entomology, Science Service, 1939. Pp. 37. (Ottawa: King's Printer.) [73

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 818: Geology and Water Resources of the Mud Lake Region, Idaho, including the Island Park Area. By Harold T. Stearns, Lester L. Bryan and Lynn Crandall. Pp. v + 125 + 13 plates. 75 cents. Water-Supply Paper 828: Surface Water Supply of the United States, 1937. Part 8: Western Gulf of Mexico Basins. Pp. vii + 437 + 1 plate. 50 cents. Water-Supply Paper 835: Surface Water Supply of Hawaii, July 1, 1936, to June 30, 1937. Pp. iv + 112. 20 cents. (Washington, D.C.: Government Printing Office.) [83

Punjab Irrigation Research Institute. Report for the Year ending April 1938. Pp. vii + 156 + 84 plates. Research Publication, Vol. 2, No. 23: An Investigation of the Inter-Relation of Silt Indices and Discharge Elements for some Regime Channels in the Punjab. By Dr. N. K Bose and Dr. J. K. Malhotra. Pp. vi + 70 + 11 plates. (Lahore: Punjab Irrigation Research Institute.) 1.10 rupees; 2*s*. 5*d*. [123 and economics; (2) a great demand for short courses of about four lectures in places where men are stationed for two months or more; and (3) an appreciable demand for classes in French and German. A scheme worked out by the staff of an evacuated school for men billeted in their area showed that the demands were in many cases more 'practical' than those described above. French and German were asked for by the majority, and next in order of popularity came shorthand and typewriting. Other requests were for mechanics, military geography and building construction. According to a reply from another battalion, contemporary history and current affairs were greatly in demand, while other topics that were repeatedly asked for included first-aid, physiology, psychology, criminology, police law and practice, etc. From the foregoing it may be seen that the provision of *ad hoc* courses would be insufficient and unsuitable for all the varied interests. The facilities provided should coincide with local demands so far as possible. Lecturers on scientific topics would be able to offer their contributions according to the regional demands.

The men in anti-aircraft and coastal defence units deserve particular attention. Many of them are desperately in need of educational facilities to relieve their long hours of monotony. It is heartening to find in Mr. Stanley's statement that for these units a more ambitious scheme involving continuous forms of education is under consideration. An official of experience in adult education is being seconded from the Board of Education and, in association with a military representative and an experienced welfare worker, is to prepare a scheme whereby educational and recreational facilities are to be developed side by side.

Considerable evidence is available to indicate the great importance of adequate library facilities to ensure the success of such a scheme, while the use of itinerant and peripatetic tutors would do much to encourage studies under adverse conditions.

The responsibilities devolving upon scientific workers to collaborate in any prepared schemes of continuous education would, if possible, be even greater than in peace-time. Astronomy, meteorology, horticulture and agriculture are subjects that have frequently been asked for by men in these isolated units, while other sciences would undoubtedly be in demand.

The supply of teaching personnel to satisfy these varying demands should not present any considerable difficulty; lecturers and tutors of all types would be more than ready to take an active part in any schemes of education that are prepared. The staffs of universities and university colleges have already expressed their willingness to contribute to the general scheme. It is to be expected that others who are interested in adult education would be available. A plea should also be made that the young school teachers who are already serving in the Forces should be made use of. Many of these teachers who have been conscripted would be glad to avail themselves of opportunities for getting practice in teaching; their adaptation to the elastic conditions that must inevitably arise should do much to increase their efficiency on their return to civil life.

Education in the Armed Forces is unquestionably a subject that is fraught with considerable difficulties. The one aim that should be constantly before our eyes is to discover the shortest method of bringing the War to a successful conclusion, and it is clearly recognized that in no circumstances must anything be allowed to interfere with military training or efficiency. But the contribution that mental alertness can make to military efficiency must also be fully grasped; its value to the peace and after is paramount. It is time, therefore, that the provisions made for educational services should be clearly stated, and a clear-cut policy adopted. To that end it is important that the schemes proposed by the Central Advisory Council should be carefully scrutinized. It is doubtful whether these schemes can be fully implemented until control is given to someone possessing the position, authority and drive enjoyed by Lord Gorell at the end of the War of 1914–18 in his capacity as head of the Army Educational Corps.

The establishment of a strong central organization would provide means whereby negotiations could be carried out with academic and professional bodies for the due recognition of the educational work done by men and women in the Forces. It could also arrange for the collection and distribution of books, films and equipment, etc. This central body would be able to co-ordinate the activities of the Central Advisory Council and the regional committees by the appointment of education officers in each battalion. The appointment of education officers would carry numerous advantages. They would be able to provide relevant information about the kind of educational services required in their particular units; they could give individual attention to all the educational problems confronting men drawn from primary and secondary schools, training colleges and universities. Thirdly, they would accompany their battalions when transferred from one district to another in Britain, and perhaps overseas.

It is important that educational facilities should not be limited to men and women in Great Britain. The extreme value of educational services in helping thousands of wounded soldiers towards recovery was strongly indicated by the Director-General of Army Medical Services in 1914–18. The acceleration of recovery through the awakening of mental interest should be a commendable feature at the present time. There has already been a steady demand overseas for lessons in the French language, the provision of which has performed useful service in consolidating Anglo-French relations. The success achieved by the introduction of these classes should be sufficient encouragement for the development and extension of educational services overseas.

ASPECTS OF THEORETICAL PHYSICS

(1) Lehrbuch der theoretischen Physik

Von Prof. Dr. Georg Joos. Dritte Auflage. Pp. xviii + 704. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 24 gold marks.

(2) Lectures on Quantum Mechanics

By Prof. M. Raziuddin Siddiqi. Vol. 1. Pp. xi + 293. (Hyderabad: Osmania University, 1938.) 6 rupees; 8*s*. 6*d*. net.

(3) Atombau und Spektrallinien

Von Prof. Arnold Sommerfeld. Band 2. Zweite umgearbeitete und erweiterte Auflage des "Wellenmechanischen Ergänzungsbandes". Pp. xi + 820. (Braunschweig: Friedr. Vieweg und Sohn, 1939.) 35 gold marks.

(4) La Chimie Mathématique

Vol. 1: Théorie Nouvelle de la Mécanique Statistique. Par Prof. Th. De Donder. Pp. 83. (Paris: Gauthier-Villars et Cie., 1938.) 40 francs.

(5) Hand- und Jahrbuch der chemischen Physik

Herausgegeben von A. Eucken und K. L. Wolf. Band 3, Teil 2, Abschnitt 3–4: Die Boltzmannsche Statistik und ihre Modifikation durch die Quantentheorie, von A. Sommerfeld und L. Waldmann; Freie Weglänge und Transporterscheinungen in Gasen, von Karl F. Herzfeld. Pp. x + 276. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 28.80 gold marks.

IF mathematical physics can justly be considered as the prototype of international science, as a language understandable to all, independent of nation and race, the present volumes not only testify to this fact, but also at the same time to the opposite statement: that differences of personality are inextinguishable and apparent even in the presentation of the most objective of sciences.

The first two books are text-books intended for the use of teachers and students. (1) Joos' work is a remarkable attempt to compress the whole of mathematical physics, up to the most modern branches, into one single volume. The success of this attempt (in Germany) is proved by the fact that three editions have been published in a few (seven) years. I have read sections of all chapters, starting with the excellent introduction on mathematical methods of physics, passing over classical mechanics, relativity, electrodynamics, thermodynamics, to the modern parts which deal with statistical mechanics, structure of atoms and molecules, quantum and wave mechanics, and ending with nuclear physics—and everything is equally well presented, clear, short and interesting. It is an admirable book, which can be warmly recommended to all who can read German fluently. Numerous examples, the solutions of which are contained in an appendix, will be very useful for the beginner.

(2) The second volume, by Siddiqi, published in Hyderabad, India, is of about the same apparent size, but covers only a narrow field, quantum mechanics. The size is in fact deceptive as the number of pages, 287, is very much smaller than that of Joos' book, 704, and the print more open; the weight of the two volumes is in the ratio 1 : 2. I should have liked to praise this book also very highly, but I have to refrain as I could not help recognizing too many features of my own lectures in Siddiqi's work. In fact, the author was among my students in Göttingen and went later to Leipzig, where he attended Heisenberg's lectures. Since Heisenberg and I had only just parted after some years of collaboration when he was my assistant, there is little wonder that his lectures were rather similar to my own.

This origin of Siddiqi's book, which can be traced even to details of notation, is partly revealed by the author as he has dedicated it to Heisenberg. There are, of course, some new sections, short references to the neutron and positron which were discovered more recently, to nuclear physics, and an outline of Dirac's theory of the electron. But as a whole, it is exactly the kind of presentation I would myself give if I ever have time enough to publish my lectures. Therefore I must frankly declare it a very good book, as regards selection of subjects, mathematical treatment, physical interpretation. As one example I wish to mention the derivation of the uncertainty principle, expressed by the formula $\Delta p . \Delta q \geqslant h/4\pi$, as given by Siddiqi in §10.6, in comparison, for example, with Sommerfeld's treatment in iii, §6, of his book (reviewed below); both are, of course, based on a well-known paper of Schrödinger (*Preuss. Akad.*, 1936), but the form of the proof given by Siddiqi, which uses the operator calculus, seems to me preferable because of its clearness. (This proof is also published in an appendix of my book "Atomic Physics".)

(3) The most important work among these five volumes is that of Sommerfeld, which reveals in every line the strong scientific personality of its author. The original work, now vol. 1 of the whole, appeared just before the discovery of wave mechanics, and Sommerfeld wrote his "Ergänzungsband" after this event as a short appendix to the main volume. But it soon became evident that this did not do justice to the importance of the new theory. Twelve years passed before Sommerfeld published this second volume, twelve years of incessant labour and continual improvement. The book has become a masterpiece indeed. The style is of the same simplicity and clearness as that of the original volume. The reader will never be puzzled by remarks like "it can easily be shown that . . ." which, in other books, indicate the presence of a particularly intricate difficulty and cost the serious student more time than the rest of the book.

Sommerfeld's work is a kind of codification of a considerable part of quantum mechanics, collecting results scattered over the literature of all nations and uniting them into a structure of great beauty. There are a great many sections containing Sommerfeld's original work, and that of his pupils. An important feature seems to me the careful derivation of normalization factors of eigen-functions, not only for discrete energy levels, but also for the continuous spectrum. These are used in a thorough study of the photo-electric effect (Chap. vi) and continuous X-ray spectra (Chap. vii). Where other books stop short because of increasing analytical complications, Sommerfeld just starts full swing, and it does not look any more involved. The Dirac electron is introduced at an early stage (Chap. iv) and used whenever spin effects are important. The treatment of the spin is a particularly fascinating feature; Sommerfeld does not use the spinor calculus generally adopted, in which the operators are 4×4 matrices with respect to the spin variable, but represents the spin properties with the help of a non-commutative algebra of sixteen units, which are formed by all independent products of four anti-commuting quantities γ_1, γ_2, γ_3, γ_4. His method of reduction of spin equations to ordinary equations, with help of null divisors (*Nullteiler*), is very powerful and simpler than the usual matrix calculus; and the relativity invariance of the equations can be shown in a most direct fashion. It is very interesting that this point of view has been recently adopted in a paper by N. Kemmer on meson theory (see *Proc. Roy. Soc.*, Nov. 1939), in which he shows that the particle aspect is better expressed by an abstract algebra, the wave aspect by a special matrix representation, both in the case of the electron and in that of the meson.

At the end of Sommerfeld's book there are several appendixes of a more mathematical character. For although the book itself contains formidable mathematics enough, it must be stressed that there is no sentence in which the physical idea is neglected or forgotten. It is a book on physics—mathematical physics, if you like—but not on 'applied' mathematics. But it demonstrates the great power of the mathematical method in describing natural laws. There is no other work which gives so full an account of the victorious path of modern theory. I hope that an English edition will be published.

(4) The next book of the collection is of the very opposite character. De Donder's new statistical mechanics is rather mathematical and formal. It can be read only by those who have a fair knowledge of the subject from other sources. The uninitiated reader would stumble over definitions the meaning of which must appear mysterious, and wonder about theorems stating results of no evident physical importance. I am myself not mathematically minded enough to appreciate the finesses of the procedure. So far as I understand it, the idea is to define all observable averages of a statistical ensemble by two kinds of derivatives, one with respect to phase volume (in the sense of Gibbs's micro-canonical ensemble), and one with respect to the number of particles (treated as a continuous variable). It is then possible to avoid all further references to ordinary counting and averaging, and to proceed quite formally.

I must confess that I was not able to follow the abstract argument. If, for example, the Bose and the Fermi statistics are derived from a general formula containing a quantity $\Delta\omega'$ (being apparently a finite increase of phase volume), by equating this $\Delta\omega'$ to $+1$ or -1 ("Faisons $\Delta\omega' = -1$; nous obtenons la loi de repartition qui caractérise la mécanique statistique de Fermi"), I feel uncomfortable and should like to ask why we are doing so. This non-physical attitude is characteristic of this book; but mathematicians may enjoy De Donder's rigorous treatment.

(5) The last volume brings us back to normal physics. It contains two articles treating statistical thermodynamics of gases, the first one in the case of equilibrium, the second one for stationary processes. Both are readable and in general up to date. The article of Sommerfeld and Waldmann gives a good account of classical and quantum statistics; it leads up to the condensation phenomenon due to van der Waals' forces, which are treated much in the traditional way, as the article was apparently sent to press a short time before the new powerful method of J. E. Mayer (*J. Chem. Phys.*, 5, 67, 74, 1937) was published. Herzfeld's article contains not only the usual considerations about transport phenomena in gases, but discusses also molecular rays, the modern methods of Chapman and Enskog, Knudsen's investigations of rarified gases, and many other questions. MAX BORN.

FRUIT PRODUCTION AND PRESERVATION

(1) The Fundamentals of Fruit Production
By Prof. Victor Ray Gardner, Frederick Charles Bradford and Henry Daggett Hooker, Jr. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. xvi + 788. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s*.

(2) Commercial Fruit and Vegetable Products
A Textbook for Student, Investigator and Manufacturer. By Prof. W. V. Cruess. (McGraw-Hill Publications in the Agricultural Sciences.) Second edition. Pp. x + 798. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 36*s*.

FOOD production and preservation are subjects which concern everyone to-day. To its furtherance science has contributed from all their fields, and no side of food production has benefited more from scientific research than that of pomology. Every stage of production from the propagation of the young tree and the breeding and selection of new varieties to the marketing of the fresh fruit or the preserved article has received intensive study. A subject so wide is difficult to present in its entirety even in two volumes as large as those under review, and any authors attempting the task of collating and condensing the mass of literature must almost inevitably omit much which to other workers will seem of prime importance.

Taken together, these two books provide an almost complete encyclopædia of the application of science to fruit production, omitting only, in the case of the first book, the aspect of pest and disease control. Both are alike in that they approach their subject from the scientific point of view rather than the empirical and practical. In the first, cultural practices are considered only in so far as they modify the relation of the plant to the complex of the environment, and it is this latter which receives first attention. In the second, while manufacturing technique is the dominating theme, the dependence of the technical processes on fundamental principles and the results of research is stressed throughout.

Unfortunately, to the student in Great Britain, both suffer from the same defect, the failure to present adequately the contributions of research workers in this country. In this respect the book by Prof. Gardner and his co-workers is open to the greater criticism. It is surprising, for example, to find no mention, in the otherwise admirable account of the seasonal changes in carbohydrates and nitrogenous substances in the apple tree, of the now classic series of investigations by Smyth, Karmarkar, Kench and others at Long Ashton Research Station. Again, a discussion of the root systems of fruit trees is very incomplete without reference to the work of Rogers at East Malling. Many other such instances might be given.

The book is divided into seven sections, dealing respectively with water relations, nutrition, temperature relations, pruning, fruit setting, propagation, and geographical influences on fruit production. The authors freely admit that comparatively little that is original is presented; their aim has rather been to survey the field of research and show how the results of scientific investigation may be applied to the problems of practical growing. It is, however, to be regretted that this second edition of a book so well known should have been prepared almost entirely by additions to the old text rather than by a thorough rewriting. In some sections this is of no consequence, as recent work has only enlarged or extended previous knowledge. The sections on pruning and propagation, however, lose greatly by the failure of the authors to re-orientate the outlook in the light of the new hormone concept of plant growth and regeneration. The revolution which this concept has brought about in physiological ideas is so great that lack of any mention is a serious omission. Nevertheless, students of pomology owe a debt of gratitude to the authors for collating so much material from the original sources and presenting it in a digested and readable form.

Prof. Cruess takes up the story at the point where the other authors leave it. His book is an exhaustive survey of the principles and practice of fruit and vegetable preservation from the commercial point of view. It is designed as a university or college text-book for courses in food technology, but will be of equal value to the scientifically minded manufacturer. As would be expected in an American book, chief attention is given to the technique of canning, which occupies about one third of the whole volume, but every product manufactured from fruit and vegetables receives adequate consideration, from dried fruits to pickles and wines. For the English student insufficient discussion is given to the manufacture of cider and perry, but this is easily understandable in a book written for American conditions where these products are of very minor importance.

Three useful and interesting chapters at the end deal with vitamins, plant pigments and the enzymes of fruit and vegetables. Prof. Cruess follows the latest American practice in re-naming vitamin B_2, vitamin G, and preserves a nice neutrality on the controversy concerning its identity with lactoflavine. The treatment of the anthocyanins is somewhat cursory in view of their importance in the appearance of canned and other products, and some review of the work of Scott-Moncreiff on the chemistry of these compounds would have added interest. The book is, however, not intended as a biochemical treatise, and it succeeds admirably in its main function of reviewing the most modern technique in food preservation.

R. H. STOUGHTON.

HUYGENS' PRINCIPLE

The Mathematical Theory of Huygens' Principle
By Prof. Bevan B. Baker and Prof. E. T. Copson. Pp. vii+156. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 12*s*. 6*d*. net.

THERE are several parts of the science of physics which appear very simple when expounded briefly in elementary text-books, but nevertheless present great difficulties when examined more carefully. A good example of this is furnished by Huygens' principle, which in its original form discusses the propagation of light by asserting that the wave front is the envelope of secondary waves whose centres are themselves on a previous wave front. The first difficulty in this elegant geometrical construction is that it gives not only the actual wave propagated forwards, but also another propagated backwards, which does not really exist. To the simple principle Huygens therefore added the special assumption that only one sheet of the envelope, namely that propagated forwards, was to be considered. The next difficulty is to explain diffraction. To do so, Fresnel replaced Huygens' isolated spherical waves by purely periodic trains of spherical waves, and made use of the principle of interference. He had to restrict his treatment to the case of small wave-lengths, and also had to make two additional assumptions concerning the relations of the amplitudes and phases of the secondary waves to those of the primary. The necessity for these two additional assumptions, which appear to be of an arbitrary character, has led some to consider Fresnel's theory as merely a convenient device for calculation without any sound physical basis. In any case, the principle so far takes no account of the phenomenon of polarization, although this was discovered by Huygens himself. In fact we may say that what was put forward as a theory of optics cannot, in anything like its original form, be legitimately applied to that branch of physics, though it may apply to acoustics. The necessity for a careful re-examination of the subject is now apparent. Unfortunately, this seems possible only on an analytical basis, with rather complicated mathematics; the elementary geometrical treatment appears to fail to give the results required, unless it is supplemented by special assumptions.

This re-examination of Huygens' principle was part of a much larger programme, covering the whole field of the partial differential equations of mathematical physics, which was the subject of a course of lectures by Prof. E. T. Whittaker sixteen years ago, and was to have been treated in a comprehensive text-book by his pupil, now Prof. B. B. Baker. Unfortunately, ill-health and pressure of other duties intervened, and Prof. Baker, in collaboration with Prof. E. T. Copson, intends to replace the projected treatise by a series of monographs, of which this is the first. The reader is assumed to have a knowledge of pure and applied mathematics roughly equal to what is possessed by an honours student of mathematics who has completed the compulsory parts of his degree course, and is about to enter upon some specialized study. The book deals with the subject in connexion with the general theory of the solutions of the partial differential equations involved, with some of the simpler diffraction problems as examples illustrating that theory.

The book contains four chapters. The first deals with Huygens' principle in what may be called its acoustical form. The theorems of Poisson and Helmholtz are given, but are shown to be included in that of Kirchhoff, which is the proper analytical formulation of the 'acoustical' principle. The two-dimensional analogue is due to Volterra. Marcel Riesz treated the case of cylindrical waves in an elegant manner, using the theory of the analytical continuation of a function of a complex variable.

The second chapter gives Kirchhoff's theory of diffraction, and the criticisms of it by Poincaré and Kottler. This theory, in addition to being difficult to apply to special problems, seems to involve conditions not intended by its author.

The third chapter takes account of polarization, and gives the three methods due to Kirchhoff, Larmor-Tedone, and Kottler. It is shown that the first and second fail, but the third appears to have overcome the difficulty of defining "blackness".

The fourth chapter gives Sommerfeld's and Voigt's methods of solving certain diffraction problems, chiefly two-dimensional, such as diffraction by a half-plane. These give results agreeing fairly well with experiment, but a rigorous theory, taking into account the properties of the material of the screen, is still lacking.

It is unfortunate that the book did not appear about the time of the original lectures. At present mathematical physicists are busy with the rapid developments of modern physics, and older problems are likely to be neglected.

H. T. H. PIAGGIO.

ENZYMES FROM MANY ASPECTS

Ergebnisse der Enzymforschung
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 8. Pp. x+324. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 28 gold marks.

THE early volumes of this annual compilation dealt with the individual enzymes, their properties and mode of action: attention is now turning to the role of enzymes in normal and pathological metabolism.

The opening article by R. W. G. Wyckoff of Pearl River, New York, deals with the subject of purified viruses, those agents of transmissible disease which are smaller than demonstrable micro-organisms. In connexion with them the question has been raised whether they are living agents or a transitional form intermediate between animate and inanimate matter. Their study may be an approach to the meaning of the term 'alive'.

The experimental problem is to get them in concentrated and purified form. More than one hundred virus diseases are now known, each with its characteristic causative agent in which a protein carries the virus. The proteins are large aggregates, and we are beginning to find out something about their size and shape by the application of a number of ingenious physical methods.

Attention is further being turned to the discovery of macromolecules in healthy tissues; several have been found in plants—they are pigmented, sediment at about the same rate, and may be macromolecular chlorophylls. They are smaller than the smallest virus proteins.

The mechanism of a still very obscure reaction, that of symbiotic nitrogen fixation, is discussed by P. W. Wilson of Madison, Wisconsin. A forty-page summary emphasizes that what is now required are experimental data rather than interpretations: the difficulty is to devise crucial experiments.

Each enzyme has in the laboratory an optimum *p*H concentration for maximum activity, but it is uncertain whether the same applies to its behaviour in the tissues. H. J. Vonk of Utrecht discusses this subject in relation to the digestive enzymes. As the various enzymes have different *p*H optima, the concentration in the intestine cannot be the best for any one of them but must be a compromise suitable more or less to all.

Enzymes are beginning to be sought for as an aid to clinical diagnosis. A rather lengthy essay by R. Ammon and E. Chytrek of Breslau summarizes present knowledge.

R. J. Dubos of New York describes the enzymatic analysis of the antigenic structure of pneumococci. It is known that the capsular polysaccharides of the different types are of paramount importance in conditioning the serological specificity and virulence of these organisms. When virulent pneumococci are treated with enzymes which destroy their capsule, they lose also the property to agglutinate in specific antiserum.

There are in all eleven articles, but enough has been said to indicate the variety of subject. The contributions are, as usual, international in source, and it is interesting to note two from Indian laboratories, though the work of Miss Scott Moncrieff was done at Cambridge.

E. F. A.

THE DRIFT OF THE ICE-BREAKER *SEDOV*

By Prof. N. N. Zubov

Attempts have been made by many expeditions to penetrate to the central part of the Arctic Ocean. A few have even succeeded in reaching the North Pole itself. After several unsuccessful attempts, the American explorer Robert Peary, on April 6, 1909, reached the North Pole on sledges drawn by dogs and remained there for some thirty hours. On May 9, 1926, the American aviator, Admiral Richard Byrd, flew to the Pole by aeroplane and describing a circle in the air, returned safely to Spitsbergen, the starting point of the flight. In the same year, the Norwegian explorer Amundsen crossed the Arctic Ocean from Spitsbergen to Alaska in a dirigible, flying over the North Pole on May 12. On May 24, 1928, the Italian expedition of General Nobile also succeeded in reaching the North Pole in a dirigible, which circled over it; but the expedition met with disaster on the return flight and some of the members perished.

Concerted attempts to reach the North Pole were made by Soviet explorers in 1937, in which year nine Soviet aeroplanes flew over the Pole. While the North Polar Station on the drifting icefloe was being set up; there were present at the Pole four heavy aeroplanes and thirty-three Soviet polar explorers. During those days five aeroplanes, piloted by Molokov, Golovin, Vodopianov, Alexeyev and Mazuruk, flew over the Pole. On June 18, 1937, Chkalov's machine passed over the Pole on his flight from Moscow to the United States. On July 13, 1937—following the same route—Gromov flew his machine over the North Pole; on August 13, Levanevsky flew over the North Pole on his way to America. Levanevsky was afterwards lost and during the search for his machine, Vodopianov flew over the Pole on October 7, 1937, and Moshkovsky on April 4, 1938.

Forerunners of the *Sedov*

Only three expeditions have drifted with the ice in the Arctic: Nansen's expedition of 1893–96 on the *Fram*, Papanin's North Polar expedition on the drifting icefloe of 1937–38, and the expedition of the Soviet polar explorers on the ice-breaker *Sedov* (Nature, 143, 837; 1939).

Nansen's expedition did not reach the North Pole. During her drift the *Fram* only reached lat. 85° 56′ N. Yet it was Nansen who, in a scientific sense, literally discovered the Arctic Ocean. Prior to the drift of the *Fram* very little indeed was known about this ocean. Nansen himself did not expect to find depths exceeding 500 m. (1,640 ft.) and consequently did not take with him the necessary equipment for sounding great depths.

From Nansen's expedition it was learned that the Arctic Ocean was a sea having depths of more than 3,000 m. (9,843 ft.). The warm Atlantic waters—a branch of the Gulf Stream—were shown to penetrate as a deep current far into the central part of the Arctic Ocean. Nansen's observations revealed the primary conditions of the movement of the ice in this basin. Lastly, Nansen also studied the principal conditions governing the formation, development and disintegration of sea ice. There is not an aspect of oceanography and geophysics relating to the Arctic Ocean to which Nansen's expedition did not make important discoveries.

On May 21, 1937, with the help of four heavy aeroplanes, the Pananin expedition was landed on the ice. On a big icefield the Soviet polar explorers set up a well-equipped polar observatory. On June 6 the organization of the North Polar Station was completed. The aeroplanes flew back to the mainland, leaving Papanin, Krenkel, Shirshov and Fedorov on the ice. They remained on the icefloe for 274 days. During this period the icefield of the Papanin expedition was carried from the North Pole to the east coast of Greenland where, at lat. 70° 54′ N. and long. 19° 48′ W., the drifting expedition was taken off by the ice-breakers *Taimyr* and *Murman*.

The men of the expedition on the drifting icefloe measured all depths along the entire course of their drift from the North Pole to the coast of Greenland. They revealed the movement of the ice and sea current under the ice which had escaped Nansen's attention. They refuted Nansen's theory that no life existed in the central part of the Arctic Ocean. They carried out valuable observations on terrestrial magnetism. The meteorological observations of the Papanin expedition not only facilitated the organization of the trans-Arctic flights of Chkalov and Gromov, but also contributed to our knowledge of the structure of the atmosphere and the processes determining the weather in the central part of the Arctic.

START OF THE *Sedov* DRIFT

Contrary to the drifts of the *Fram* and the North Polar Expedition on the drifting icefloe, the drift of the *Sedov* was not deliberately planned. With the ice-breakers *Sadko* and *Malygin*, on October 23, 1937, the *Sedov* was caught in the ice in the Laptev Sea at lat. 75° 19′ N. and long. 132° 25′ E. On August 28, 1938, these ice-breakers were at lat. 83° 06′ N., long. 138° 24′ E. On that day the ice-breaker *Yermak* extricated the *Sadko* and *Malygin* from the ice and brought them into clear water. The *Sedov*, however, could not be released owing to the fact that during her imprisonment in the ice she had sustained some damage to her steering gear.

Fifteen volunteers, headed by Captain Badygin, remained on the *Sedov*; and from that time the vessel continued her remarkable drift in the most inaccessible part of the Arctic Ocean, where no other vessel had ever drifted before and no aeroplane had flown.

Several circumstances make the drift of the *Sedov* of exceptional interest. First, the drift of the ice-breaker began at a time when the North Polar Expedition on the drifting icefloe was still making observations. Thus, uninterrupted observations of the central parts of the Arctic Ocean were being conducted. Secondly, soon after the commencement of the drift of the *Sedov* and also in the Laptev Sea but in the south-western part, there began the drift of several vessels headed by the ice-breaker *Lenin*. These vessels had been carried from Khatanga Bay. The drift of the ice-breaker *Lenin* ended on August 7, 1938, when, with the entire caravan of ships, she was extricated from the ice by the *Krassin*. Thus, for nine months two caravans of ships drifted simultaneously at some distance from each other, one in the south-western part of the Laptev Sea, the other in the north-eastern part of the same sea, and in the region to the north of the New Siberian Islands.

A comparison of these drifts has yielded noteworthy results. Differing from each other in details, these drifts at the same time reveal extraordinary similarity, a fact which goes to show that they were conditioned by the same causes: the prevailing winds and constant currents.

Thirdly, soon after the commencement of her drift, the *Sedov* found herself in the region where the drift of Nansen's *Fram* started.

A comparison of the subsequent courses of the drifts of the *Fram* and the *Sedov* is of exceptional interest, because the former took place in climatic conditions differing considerably from those of the present day. At first the *Sedov* drifted directly northwards. In a month, under the influence of west winds the ice-breaker turned eastwards, and early in January, 1938, reached the most easterly point of her course—lat. 78° 25′ N. and long. 153° 26′ E. From that time the *Sedov* began slowly to move westwards, at the same time going more and more to the north. She continued this north-westerly direction, and on March 22, 1939, reached lat. 86° 34·7′ N. and long. 108° 50′ E. Later, the drift began gradually to incline to the south-west. From May 17 until July 27, 1939, the courses of the *Sedov* and the *Fram* overlap, as it were, but afterwards the *Sedov* again commenced to go rapidly to the north, and on August 29, 1939, reached the northernmost point of her drift, lat. 86° 39·5′ N., long. 47° 55′ E. After that the *Sedov* again descended to the south, crossing the *Fram's* course, and along a line lying between the drifts of the expedition on the drifting icefloe and that of the *Fram*, made for the broad strait dividing Greenland from Spitsbergen. From December 1, 1939, the *Sedov* was finally drawn into the drift of the ice moving from the Arctic Basin to the Greenland Sea; with gradually increasing speed the ice-breaker drifted almost due south. On January 1, 1940, she had already reached lat. 81° 15·4′ N., long. 4° 16′ E. She was afterwards extricated from the ice by the ice-breaker, *Joseph Stalin*. Her crew was taken off the vessel on January 13, and on January 29, 1940, the *Sedov* arrived in Murmansk.

END OF A LEGEND

One achievement of the *Sedov* is the final explosion of the Sannikov Land legend. In 1811 Jacob Sannikov purported to have sighted from the northern coast of Kotelny Island a high land which he attempted to reach by crossing the ice; he was prevented from doing so by a big polynia (an expanse of clear water in the icefield). According to Sannikov, there remained only another 25 kilometres (15½ miles) for him to cross in order to reach this land. Doubts as to the existence of this supposed land have, however, been held by many for several decades.

The *Sedov*, during the period of her drift, twice crossed the region of the supposed land: once from west to east, approximately at the 78th parallel, and the second time from the south-east to the north-west. Later, the air expedition of Alexeyev passed over the region approximately in a meridianal direction. The flights were from the northern extremity of Kotelny Island to the drifting caravan of vessels, the *Sadko*, *Sedov* and *Malygin*, and were made at a time when visibility was excellent.

Through this same region also passed the ice-breakers *Yermak* and *Joseph Stalin* on their way to meet the drifting vessels. Yet neither ice-breaker saw any sign of 'Sannikov Land'.

Boundary of the Laptev Sea

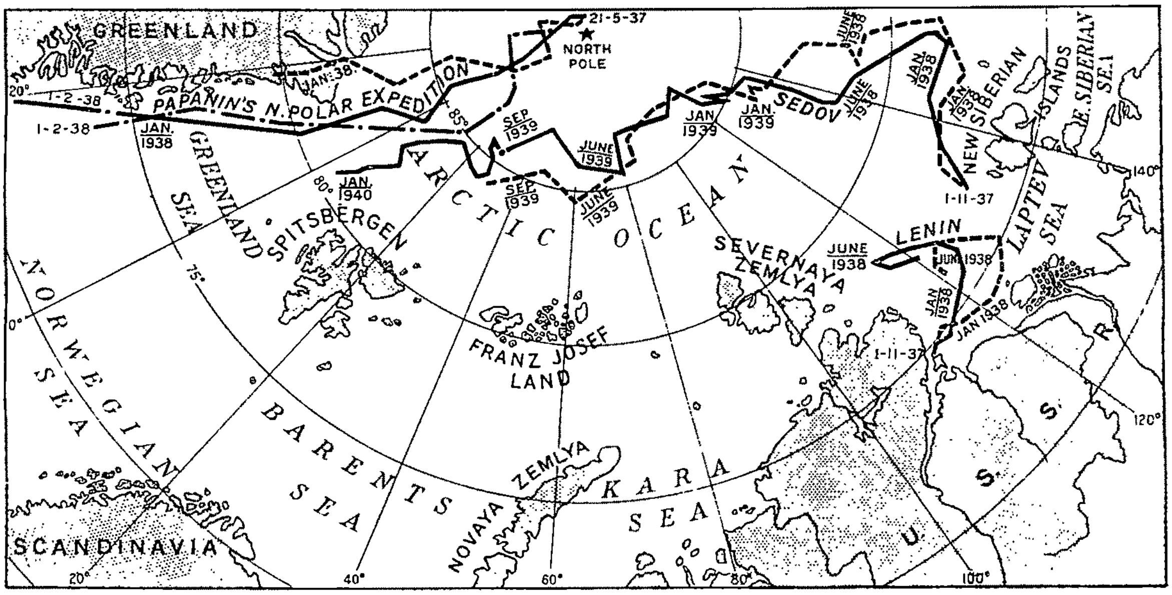
From the point of view of physical geography, the Laptev Sea is not a sea but only a gulf of the Arctic Ocean. The northern boundary of this sea is conditional, having been fixed by the Soviet Government as the arc of the great circle connecting Cape Molotov (the northern point of Severnaya Zemlya) with the point at which the meridian crosses the northern point of Kotalny Island (long. 139° E.) and the edge of the continental shelf. The drift of the *Sedov* from the beginning up to lat. 79° 37′ N., long. 149° 58′ E. proceeded along the continental shelf. The depths did not exceed 200 m. However, at lat. 79° 52′ N., long. 148° 02′ E., the *Sedov* found herself over depths considerably exceeding 3,000 m., that is, at depths characteristic of the deep bed of the central part of the Arctic Ocean.

The region lying to the north of the New Siberian Islands has been thoroughly sounded. From a comparison of these soundings, it appears most probable that the continental shelf at the Kotelny Island meridian (long. 139° E.) ends at lat. 78° 30′ N. This must be considered as the north-eastern point of the Laptev Sea.

As was found in the region of the New Siberian Islands, the continental shelf stretches farther north than was supposed, and the continental slope is much more gradual. It occupies 2° of latitude and has a gradient of not more than 1.

To the north of Franz Josef Land great depths were unexpectedly discovered. At lat. 86° 26·6′ N., and long. 39° 25′ E. the expedition failed to find bottom at 5,180 m.

Extremely interesting are the soundings obtained by the *Sedov* in the latter stages of her drift—at the entrance to the Greenland Sea. Nansen surmised that between the north-eastern extremity of Greenland and the north-western extremity of Spitsbergen was a submarine ridge separating the great depths of the Arctic Ocean from the great depths of the Greenland Sea. This ridge came to be known as Nansen's submarine ridge. Its eastern part was studied in 1935 by the *Sadko* expedition, and the western part by the Papanin North Polar Expedition on the drifting icefloe. The *Sedov* crossed Nansen's submarine ridge in its middle part, at lat. 81° 34′ N., long. 4° 40′ E., and registered a depth of 1,500 m., thus confirming the existence of this ridge.


GREENLAND
21-5-37
NORTH POLE
1-2-38
1-2-38
JAN. 1938
PAPANIN'S N. POLAR EXPEDITION
JAN. 38
SEP. 1939
JUNE 1939
JAN. 1940
SEP. 1939
JUNE 1939
JAN. 1939
JAN. 1939
SEDOV
JUNE 1938
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JUNE 1938
NEW SIBERIAN ISLANDS
E. SIBERIAN SEA
NEW
1-11-37
LENIN
JUNE 1938
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JAN. 1938
1-11-37
LAPTEV SEA
ARCTIC OCEAN
GREENLAND SEA
SPITSBERGEN
SEVERNAYA ZEMLYA
FRANZ JOSEF LAND
NORWEGIAN SEA
BARENTS SEA
NOVAYA ZEMLYA
KARA SEA
SCANDINAVIA
U. S. S. R.
85°
80°
75°
20°
0°
20°
40°
60°
80°
100°
120°
140°

The Russian Drifts.

——— actual drift, ------- theoretical drift without account of constant currents. —·—·— theoretical drift with account of constant currents.

Changes in the Thermal Balance

In addition to the sounding of depths, the *Sedov* crew carried out meteorological, hydrological magnetic and gravimetrical observations along the same lines as the members of the North Polar Expedition on the drifting icefloe. The observations of the *Sedov* crew confirmed what has already been recorded by the Papanin expedition and by Nansen: on the whole course of their drift they discovered at intermediate depths warm waters of Atlantic origin.

The fact that the lines of the drifts of the *Fram* and the *Sedov* crossed in several places has made it possible to determine the changes in the thermal balance of the Arctic Basin during the last forty-five years.

The *Sedov* remained twice as long beyond the 85th parallel as the North Polar Expedition on the drifting icefloe, and two and a half times as long as the *Fram*, though the drift of the latter lasted nearly three years. The *Sedov* began her drift considerably farther south than the *Fram*, and at the end of it she descended to more southerly latitudes than Nansen's vessel, yet the *Sedov's* drift lasted only 26½ months. This indicates that the speed of the *Sedov's* drift was considerably greater than that of the *Fram*.

The increased movement of ice from the Arctic Basin into the Greenland Sea is accompanied by an increase in the flow of warm Atlantic waters into the polar basin, a reduction in the volume of ice in seas bordering on the Arctic, a decrease in the thickness of polar ice and size of glaciers, and also by a rise in the winter temperatures of the air. All these phenomena are characteristic of the warmer temperatures we are now observing in the Arctic.

Notwithstanding the fact that the line of the *Sedov's* drift was considerably more northerly than the line of the *Fram's* drift, the winter months in the Arctic in Nansen's time were several degrees colder than at the present time. The lowest temperature of the air (—44·1°) was registered by the *Sedov's* crew on March 10, 1939, at lat. 86° 23′ N., long. 110° 20′ E. The lowest temperature during the drift of the *Fram* (—52°) was registered on January 15, 1896, approximately at lat. 84° 55′ N., long. 41° E., that is, appreciably more south-west than the spot where the *Sedov's* lowest temperature was registered and where, as a rule, it is warmer.

The thickness of level ice according to the measurements of the *Sedov's* crew was not more than 218 cm. (7 ft. 2 in.). Nansen's expedition encountered ice 365 cm. in thickness. Analysis has shown that the lesser thickness of the ice in the region of the *Sedov's* drift was due not so much to the rise of the winter temperatures of the air as to the melting of the ice in recent years in summer time.

BELT OF HUMMOCKS

In the light of the observations made by the *Sedov's* crew, interest is attached to questions concerning the maximum thickness of the ice. The members of the North Polar Expedition on the drifting icefloe never encountered ice of a greater thickness than 218 cm. That being the case, where was the icefield on which the expedition set up its observation station formed, and how did it reach the North Pole ? We know that this icefield was more than 3 m. thick. Why was the *Sedov*, which on March 22, 1939, was 180 km. (97·12 nautical miles) farther to the north than the *Fram* and afterwards, like the *Fram*, turned westwards, unable to penetrate to the 87th parallel ? The highest latitude reached by the *Fram* was 85° 55·5′ ; the highest latitude reached by the *Sedov* was 86° 39·5′. The northernmost point reached by Nansen during his sledge journey to the North Pole was lat. 86° 14′ ; lastly, in 1900 Cagni in the same region reached lat. 86° 34′ N. Both Nansen and Cagni were prevented from going farther north by impenetrable hummocky ice.

These data should be compared with the observations made by Alexeyev during his flights from Franz Josef Land to the North Pole and back. Alexeyev ascertained that from Rudolf Island up to lat. 82° 30′ N. lie hummocky fields of young ice dotted with icebergs. Higher, up to lat. 85° 30′ N., the size of the icefields increases, reaching 20 km. across. On these fields are level platforms suitable for the landing of aeroplanes. At the 84th parallel the thickness of the ice did not exceed 100–120 cm. Beyond 85° 30′ commenced an icefield of ice many years old, while up to the 86th parallel the icefields were small and hummocky, and the lanes between the icefields were filled with broken ice. In these places it was impossible to land aeroplanes. Farther north, particularly between 87° and 88° 30′, the icefields appeared more suitable for landing-places. The condition of the ice in the region of the North Polar Expedition on the drifting icefloe is already known.

From the foregoing, we see that between the North Pole and Franz Josef Land is situated a belt of hummocks of a peculiar character. This belt separates the younger ice, formed mainly on the continental shelf of Eurasia, from the thicker ice near the North Pole. It seems that this belt of hummocks which, in its time, had stopped the further advance to the north of Nansen and Cagni, is a permanent feature.

NANSEN'S LAWS

Four times a day the men on the *Sedov* transmitted by radio their position and meteorological observations. This made possible a comparison of the ice drift with the wind causing the drift. Such observations made near coasts are usually distorted by the nearness of land and shallows ; and so, for a theoretical study we are only able to use the data supplied by three drifts, those of the *Fram*, of the Papanin North Polar Expedition on the drifting icefloe (while it was in the central part of the Arctic Ocean) and of the *Sedov*.

Like all known drifts, the drift of the *Sedov* did not proceed in a straight line. The ice-breaker often turned back on her course, described zigzags and even loops. These changes of direction were caused by changes in the direction and velocity of the wind. In this connexion, very characteristic are the figure 8 described by the *Sedov* between October 2 and 26, and the zigzags between November 10 and 30, 1938, and the loop she made between January 3 and 17, 1939.

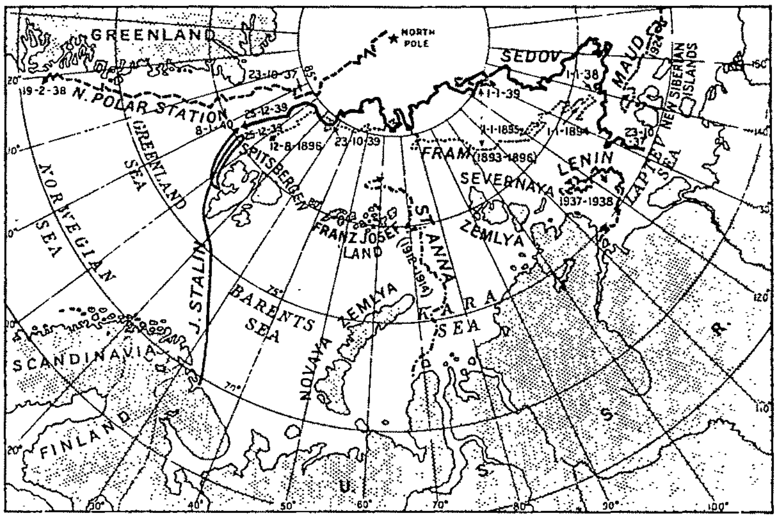
The only difference between the direction of the drift and the direction of the wind was that the drift was deflected 30°–40° to the right. Any deviation from this law can be attributed to the incompleteness of the *Sedov's* observations at my disposal.

The observations of the *Sedov* worked out by me show that in the region where the *Sedov* drifted between September 1, 1938, and February 1, 1939, the constant current was so weak that it might be said to have been absent. As a result, almost laboratory conditions prevailed for the study of the relations between wind and drift. Far removed from the distorting influence of land and constant currents, the wind drift was shown here practically in its pure form.

In this way it was possible to confirm yet again the exactness of the two simple laws of Nansen determining the behaviour of solid ice in the central part of the Arctic Basin. These laws are as follows :

(1) The speed of the wind drift is approximately one fiftieth of the velocity of the wind causing the drift.

(2) The drift of the ice is deflected from the direction of the wind by 30°–40° to the right owing to the influence of the deflecting force of the earth's rotation.



Drifts of the *Maud, St. Anna, Fram,* the ice-breakers *Lenin, Sedov* and Papanin's North Polar Expedition, and also the course of the ice-breaker *Joseph Stalin.*

Two Additional Laws

A study of the drift of the *Sedov* makes it possible to add to Nansen's two laws two other equally simple laws :

(3) The drift of the ice follows the isobars. The ice drifts along these lines in such a way that the region of high pressure is to the right of the direction of the drift, and the region of low pressure to the left.

(4) The drift of the ice takes place at a speed proportional to the gradient of atmospheric pressure, or in other words, inversely as the distance between the isobars.

The first of these additional laws is not difficult to deduce. In moderate and high latitudes the wind, due to friction against the surface of the earth and to the influence of the deflecting force of the earth's rotation, is directed approximately 30°–40° to the left of the corresponding isobar. The drift of the ice, according to the second of Nansen's laws, is deflected from the direction of the wind approximately by 30°–40° to the right. Combining the two, we arrive at the drift of the ice along the isobar.

The second additional law was arrived at thus In the absence of constant currents and the deflecting influence of land, the ice moves at a speed proportional to the velocity of the wind. The latter, in its turn, is proportional to the gradient of atmospheric pressure ; the closer the isobars are drawn on the synoptic chart for any given region, the stronger are the winds in that region. From this, supported by purely theoretical deductions, it was possible to judge from the synoptic chart not only the direction of the ice drift, but also its speed.

Theoretical calculations made on the basis of the new laws confirm the hypothesis that the ice moves clockwise around the so-called 'pole of inaccessibility'. Had the *Sedov* in January and February 1939 been somewhat more north than she actually was at that time, it is highly probable that she would have been drawn into this clockwise movement around the 'pole of inaccessibility' and would have been drifting now towards the northern coasts of America.

The new laws offer an explanation of the known drifts of vessels and buoys and also of such arctic phenomena as 'Peary's polynia' at the coast of Greenland, also the 'Great Siberian polynia' stretching with interruptions from the New Siberian Islands to the Chukotsk Sea. These polynias coincide with the lines of separation of the ice, or in other words, with the lines of the divergence of the isobars.

The movement of the ice along the isobars also explains why Amundsen's *Maud*, when entering the ice at Wrangel Island for the purpose of drifting across the North Pole, moved with the ice along the continental slope of the Asiatic coast, that is, along the parallel and not the meridian. It appears that the isobars in the vicinity of Wrangel Island both winter and summer stretch along the parallels. In order to drift with the ice to the North Pole it would be better to enter the ice in the region of the Beaufort Sea, whence, apparently, the icefield occupied by Papanin's North Polar Expedition was carried.

THEORETICAL DRIFT AND ACTUAL DRIFT

On the basis of the monthly charts of pressure, the theoretical drifts were plotted of Papanin's North Polar Expedition (May 21, 1937, to February 1, 1938), of the ice-breakers *Sedov* (November 1, 1937, to October 1, 1938) and *Lenin*. Afterwards, according to latitude and longitude, the actual drifts of these vessels were indicated on the chart. The similarity between the lines of the theoretical drifts and those of the actual drifts was noteworthy.

The actual drifts of the *Sedov* and of the *Lenin* came very near those calculated by theory. There was, however, considerable difference between the actual and theoretical drifts of Papanin's North Polar Expedition. In the first place, the theoretical drift of Papanin's Expedition came out to the coast of Greenland, and in the second place, it was shorter than the actual drift (if calculated by latitude) by 550 nautical miles. This difference is accounted for by the fact that in calculating the theoretical drifts, account was taken only of the influence of local winds, whereas the movement of the ice is conditioned not only by winds, but also by constant currents.

Naturally, in regions where the constant currents are weak, the influence of local winds on the speed and direction of the drift is paramount. With the approach to the Greenland Sea, the local winds, owing to the strong East Greenland current, have less and less influence on the icefields. The weak winds, the direction of which is contrary to that of the constant current, now only slow down or delay for a time the general drift to the south. This happened in the case of Papanin's North Polar Expedition, and also in the case of the *Sedov*.

The difference between the actual and theoretical drifts of the Papanin North Polar Expedition is also connected with the speed of the wind drift of mass icefields in the central Arctic. This is one fiftieth of the velocity of the wind causing the drift; but the speed of the drift of ice under the influence of wind is considerably increased if ahead of the ice, in the direction of the wind, is open sea. In this case, the speed of the drift may reach one tenth of the velocity of the wind or sometimes even more. Conditions such as these are created when north and west winds prevail in the region of the central Arctic adjoining the Greenland Sea, or in the Greenland Sea itself.

In this sea, along the east coast of Greenland right up to lat. 60° N., summer and winter there moves to the south an uninterrupted line of polar ice carried from the Arctic Basin by the East Greenland current. At the same time, to the north, along the west coasts of Scandinavia and Spitsbergen, flow warm Atlantic waters, which as a deep current later penetrate into the Arctic Basin. Owing to this, the eastern edge of the Greenland ice stretches approximately from Iceland through Jan Mayen Island to the north, up to the northwestern extremity of Spitsbergen. In the summer, the edge recedes to the west, and in the region situated to the north of Spitsbergen, in some years goes up to lat. 82° N. In winter-time, the edge of the ice in the Greenland Sea moves somewhat to the east and at Spitsbergen descends to lat. 80° N. and lower. With western and northern winds the edge of the ice recedes to the east, the ice becoming somewhat less closely packed; with eastern and southern winds the edge of the ice recedes to the west and the ice becomes much more closely packed. Thus in the eastern part of the Greenland Sea at any time of the year are immense ice-free stretches of water.

THE GREENLAND STREAM

Every year there flows into the Arctic Ocean about 5,000 cubic kilometres of river water. In addition about 30,000 cubic kilometres of Pacific waters and more than 100,000 cubic kilometres of warm Atlantic waters flow into the Arctic basin through the Bering Strait annually. A small proportion of this water passes into the Baffin Sea but the bulk flows into the Greenland Sea through the broad strait between Greenland and Spitsbergen, forming the East Greenland current. This current is maintained and considerably strengthened by the north and north-west winds which predominate on the east coast of Greenland.

As observations have shown, in the central basin, the speed of the constant current towards the Greenland Sea is not great: it is less than one nautical mile a day. But on approaching the Greenland Sea and within the Greenland Sea, the speed of the constant current increases. According to the calculations of Shirshov and Fedorov (of Papanin's North Polar Expedition), near the 83rd parallel the speed of the constant current towards the south reaches 4 km., near the 80th it is 6 km. and near the 75th parallel it is 9 km. a day.

At the end of August 1939, reaching the northernmost point of her drift, the *Sedov* began quickly to descend to the south-west, becoming gradually drawn into the Greenland current. From December 1, 1939, the drift proceeded due south, almost parallel to the drift of Papanin's North Polar Expedition, almost at the same speed with which the latter had drifted in that region two years previously.

During the period of its drift, Papanin's North Polar Expedition descended about 1,120 nautical miles to the south latitudinally. This route was covered under the influence of the constant current and local winds. If account is taken of the data of Shirshov and Fedorov concerning the direction and speed of the current, it appears that about 600 nautical miles of the total length of the drift was due to the accompanying sea currents, and only 520 nautical miles to accompanying winds. At the same time, the theoretical drift for the *Sedov* was shorter than the actual drift by 550 nautical miles, because when plotting it, we gave consideration only to local winds.

Taking into account the observations and calculations of Shirshov and Fedorov, we attempted to calculate the entire drift of Papanin's Expedition caused, on one hand, by the distribution of atmospheric pressure, and on the other, by the constant current. The results of this calculation made by myself with the help of my assistant, Mr. Somov, are of interest. Comparing the actual position of Papanin's North Polar Expedition on February 1, 1938, with the theoretical position, calculated according to my formulæ, with due account of the constant current, we find that the actual position of the Expedition differed from the theoretical position only by 50 miles in latitude, or only by 5 per cent of the total length of the drift in latitude. This comparison may be regarded as bordering on the limits of accuracy with which the original data were obtained.

DEVELOPMENT OF LONG-RANGE AIRCRAFT*

AEROPLANES as a means of transport become increasingly attractive as their range increases. For short journeys the saving in time is often negligible, especially in a country in which other forms of carriage are well developed, but on long routes, particularly trans-oceanic services, the time saved may amount to days or even weeks. Long range demands large fuel capacity, and the peculiar conditions in aircraft may reduce the pay load until it becomes uneconomic, and eventually the limiting range is reached over which no pay load can be carried. The principal problem associated with this is the difficulty of taking a heavily loaded aeroplane off the ground. When flying free, a heavier-than-aircraft is capable of carrying a much bigger load than that which it can lift off the surface of a normal aerodrome. The hazard of a heavily loaded take-off is considerable, particularly when the machine has just left the ground. If at this moment there should be an engine failure (and it is a time when engines appear to be liable to fail, due possibly to some small maladjustment during their overhaul since last being run, which develops into a failure catastrophically) the results will almost certainly be serious, as it is necessary to land at high speed with little or no choice of landing site.

It was with these points in mind that Sir Alan Cobham began several years ago to develop his system of refuelling in flight. His aim was to allow an aircraft to take off light, with very little of the required fuel on board, which on a long-range machine may amount to as much as 25–30 per cent of its all-up loaded weight. Its take-off would thus be comparatively safe, as its preliminary run would be short and the climb away from the ground relatively steep until it has reached a safe operating height. A flying tanker would then come alongside and deliver the fuel to give it range. This scheme has been successful in the regular operation of the North Atlantic service by Imperial Airways Limited last summer, in which the *S*.30 flying boats were refuelled at Foynes or Botwood before they commenced the ocean crossing. These flights are to be resumed during this summer, and will probably continue until the ice on Botwood Harbour closes them down for the winter.

Many methods of assisting the take-off have been suggested, and they may be classified under four headings :

(1) *Improvement of Thrust.* (*a*) Controllable pitch airscrews. (*b*) Ground boosting of the power plant, including the use of high-octane fuel.

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* Based upon (1) "Report on the Effects of Large Increments in Wing and Power Loadings on the Performance of Aircraft" by Marcus Langley ; (2) "Static Electricity in Relation to Refuelling in Flight" by Marcus Langley and H. M. Barlow ; (3) "Landing Speed and Ceiling in Relation to Refuelling in Flight" by Marcus Langley Flight Refuelling Limited, Ford Aerodrome, Yapton, Arundel, Sussex.)

(*c*) Catapulting, inclined runways, etc. (*d*) Mayo Composite aircraft.

(2) *Reduction of Drag.* Reduction of coefficient of friction by means of bogey on rails, concrete runways, etc.

(3) *Improvement of Lift.* (*a*) Flaps of various designs, including mechanical variation of wing camber. (*b*) Makhonine's span-wise variation of area. (*c*) Use of slipstream and angle of thrust line relative to wing, according to the Crouch-Bolas patents. (*d*) Mayo Composite aircraft.

(4) *Reduction of Weight.* Addition of fuel, subsequent to the take-off, by the methods of Flight Refuelling Ltd.

Combinations of these methods are found in the design of most modern transport and military aircraft. Thus it is now usual to fit an air liner with controllable-pitch airscrews, ground-boosted power plants, and low-drag flaps, to gain some advantage from the slipstream in improved lift, and to operate it from aerodromes having concrete runways. It is only by these methods that loadings as high as those now used are possible, but these are far from being the optimum loadings in flight.

Certain of the methods, particularly those which imply the use of specially prepared aerodromes, are not suitable for military aircraft. Others are not particularly suitable for passenger purposes. For example, the acceleration of a catapult used for a passenger transport would have to be relatively low, and consequently its design would be elaborate, and its cost, weight and dimensions prohibitive. In any event, unless such methods assist the initial climb in order to clear obstructions outside the aerodrome, as well as shorten the take-off run, they provide only a partial solution of the problem. This suggests an alternative classification of these methods:

(*a*) those which are substantially safe; and
(*b*) those which introduce a hazard.

Under the second heading might be put catapults, inclined runways, over-sized aerodromes, and, in fact, any method the assistance of which is withdrawn at the moment the aircraft leaves the ground.

Refuelling is of greatest value in allowing the operation of trans-oceanic air routes of 3,000 miles or more, where no intermediate landing is possible. There is an agreed international limit for take-off run by which a civil aircraft must be able to clear a 60 ft. barrier 656 yards from its starting point. It is possible to design a normal modern air liner capable of carrying a reasonable pay load over a distance of 3,000 miles, and to keep within this limit of take-off. Additional range, demanding extra weight of fuel, can only be had at the expense of lengthening the take-off run and reducing the angle of climb, or alternatively reducing the pay load. If the machine were refuelled after leaving the ground, its take-off could be reduced by half.

A similar air liner could be designed which, with the aid of refuelling, would be able to fly 5,000 miles with about the same pay load as that carried by the normal machine for 3,000 miles, and its take-off run would still be less than 400 yards with an angle of climb of $11\frac{1}{2}°$. The corresponding normal aircraft would require more than 1,000 yards if it had to take this load off the ground, and it could climb at an angle of only 5°.

Many practical problems have had to be solved before the process could be considered sufficiently safe and reliable for everyday use. A complete set of equipment has been developed for both the tanker aircraft and the machine which receives the fuel. Flying problems have had to be explored, so that the operation could be carried out in any condition of weather in daylight or at night.

It is now simple and quick. The receiving aircraft flies a straight and level course when it has climbed to its operating height. It streams out a hauling line with a sinker weight attached through the receiver coupling in its tail, and the tanker comes up behind and to one side, and fires a line across this. The contact thus having been established, it is a simple matter to attach the nozzle of the hose pipe to the receiving aircraft's hauling line. The hose is paid out and the nozzle pulled by a windlass into the coupling, where it is retained by hydraulically operated claws. During this coupling-up process the tanker has climbed into the refuelling position above, behind and to one side of the liner. Approximately 200 ft. of hose is used for a separation between the aircraft of 100 ft. The hose thus trails back in a hairpin bend, and if it were to break or come adrift it would fall clear of both machines. The coupling is non-jammable and is fitted with an automatic release, so that the nozzle will come away should it be necessary for the aircraft to part in an emergency. For the Atlantic service, a 2-in. bore hose was used, and with a gravity head of 60 ft. the rate of flow was of the order of 110 gallons a minute. The whole process of transferring 800 gallons took 12–15 minutes, of which about five minutes was spent in making contact and getting the hose across, and some seven minutes in actually passing the fuel.

Among the many interesting secondary problems were those associated with static electricity. The two aircraft might be at a different potential and charges might be built up in the hose pipe due to friction. There was a further chance of electrification by splash as the petrol rushed into the receiving tanks. Methods have been evolved to overcome all these possible dangers. The two machines are completely bonded together throughout the whole process by means of the spiral steel wire armouring on the outside of the hose pipe. The whole system is flushed through with nitrogen from the tanker both before and after the passing of the petrol. At the moment of break-away, the contents of a bottle of methyl bromide are automatically sprayed into the receiver coupling, and the final contact is eventually broken in mid-air by snapping a weak link in the hauling line as the aircraft part company.

It is difficult to foresee all of the ramifications of the post-War developments of civil aviation, but the establishing of rapid transport of mails and passengers over the long ocean routes between the continents is one of the most obvious. This will scarcely be possible as a self-supporting economic proposition with present-day aircraft, unless in the meantime some revolutionary discoveries are made either in the aerodynamic design of aircraft, or in the design of power units. It is possible to visualize at least an approach to this ideal by making use of refuelling in flight, using the most up-to-date design of aircraft as now accepted. During the War its development is going on, but little may be said about its possibilities for military purposes.

OBITUARIES

Dr. R. T. Gunther

WE regret to record the death on March 9 of Dr. Robert William Theodore Gunther, a great student of science and the founder in the Old Ashmolean Building of the Oxford Museum for the History of Science. With him there passes the last of the Oxford science tutors appointed in the early and middle 'nineties and a learned, aloof, enigmatic, single-minded and essentially good man.

Gunther was born in 1869, the eldest son of Dr. Albert Günther, the zoologist, and educated at University College School, London, and Magdalen College, Oxford. He had wide scientific interests as a boy—in geography, chemistry, practical mechanics and biology. The combined influences of his father and of Ray Lankester, whom Gunther greatly admired, led him to take his B.A. degree in biology. He obtained, as one could in those days, a first class in morphology in 1892, and shortly afterwards was appointed tutor in science at Magdalen. A few years later he became a fellow. Few men read science at Magdalen in the 'nineties, and Gunther, unlike the busy tutor of to-day who divides his time between work and research in the laboratory and tutorial hours in college, was a free man. He went with an endowment to Naples to work in the Marine Laboratory there, and between 1897 and 1914 travelled widely, studying the natural history of lakes in Persia and the geology of extinct volcanoes and surveying the entire coast-line of Italy. His first publications were on subjects in biology and geology, but his intense devotion to the memory of Prof. Charles Daubeny of Magdalen College helped to deflect his interests from the present to the past, from Nature to documents and instruments, from research in laboratories to pieces in museums. His history of the Daubeny Laboratory of Magdalen College came out in 1904, and annotated registers of those who had worked in it were published in 1916 and 1924. His love of collecting material relating to the past and arranging it for publication was shown in his monographs on his own family, on his wife's family, on the monuments in Magdalen Chapel, and similar subjects, brought out in the period 1910–14.

After the War of 1914–18, Gunther devoted himself to collecting for exhibition scientific and mathematical instruments of the past, especially of Oxford's past, and to editing the little-known or forgotten works of Oxford's early scientific men, of whom Robert Hooke was first favourite. In the period 1920–37 he brought out no fewer than eleven volumes on these men and their works, in addition to works on astrolabes, early libraries, and other subjects. Anything 'early' and 'scientific', even in Cambridge, whatever its present relevance or value, interested him greatly and, he believed, would interest others too. One old instrument, blunt and rusty, one old book, with a few good scientific ideas in it, gave him joy when ninety-nine particle-counters or up-to-date text-books left him lukewarm. It was unfortunate that some of the publications received adverse and even trenchant criticism. It was not that Gunther was constitutionally inaccurate or that he would not take sufficient trouble with his material; it was that he would do everything himself. He never collaborated or took advice. He went his own way. He did his best. When up against a difficulty he preferred to surmise rather than to seek someone who knew the answer. This temperamental weakness was best revealed in his large work on early astrolabes where criticism which he could have got in Oxford, indeed, in his own College, was delivered more vigorously than helpfully after, instead of before publication.

During the War of 1914–18 Gunther became curator of the Botanic Garden in Oxford, and from 1920 until 1923 the librarian of Magdalen. In the 'twenties the rooms in Daubeny's buildings, where he was amassing his instruments and books, with Daubeny's eighteenth century chemical-ware as its nucleus, were needed as lecture rooms and laboratories. Gunther took it ill when his College asked him to leave and take the material elsewhere. There was, in consequence, a breach, inevitable between a College alive to the needs of the twentieth century and one who was essentially a seventeenth century antiquarian. The breach, however, brought out the best in Gunther's fighting qualities. He determined that Oxford should have a museum for the history of science that would be unique. Almost no one in Oxford but himself was interested in that kind of museum. He set out, decisively and even gallantly, to achieve his purpose. He had a talent for relating means to ends, for making just so much impression on individuals and colleges as would extract from them what he wanted, for doing just so much canvassing as was needed to gain his particular point in the courts of the University. At times he did not invite, he commanded; city magnates came to Oxford to unveil memorial windows; presidents of the Royal Society came at his bidding to commemorative luncheons; chancellors and heads of colleges signed his appeals in *The Times*. In 1924 he became the curator of the Lewis Evans collection of scientific instruments, and this nucleus became the museum for the history of science in the Old Ashmolean building in Broad Street, Oxford, in 1935. To-day the collection is unique and, but for the War, would be in a lovely setting. Gunther's single-handed fight to collect this material and to get it into the building, where it now is, will not have been in vain if someone can now be found to succeed him as curator and in the University readership in the history of science. The museum is his fine achievement, a witness to what one man by himself can do.

Gunther married Amy Neville-Rolfe, daughter of a former consul-general at Naples. He had two sons, the elder of whom was zoologist to the recent *Discovery* expeditions. A. S. RUSSELL.

Prof. D. S. Margoliouth, F.B.A.

WE regret to record the death of Prof. D. S. Margoliouth, for many years a foremost authority in Oriental studies and formerly Laudian professor of Arabic in the University of Oxford, which took place on March 22 in the Middlesex Hospital, London, at the age of eighty-one.

David Samuel Margoliouth was born in 1858 of Hebrew Polish stock. The son of an Anglican missionary to the Jews, he was educated at Winchester and New College, Oxford. Both at school and at the university he was of outstanding ability, and showed a remarkable and unusually early maturity in classical studies, being awarded both the Hertford and the Ireland Scholarships in his first year as an undergraduate. Later he turned to Oriental studies, winning all the University prizes open to him in this field. In 1881 he was appointed fellow and lecturer in classics; and eight years later he entered upon his occupancy of the Laudian professorship, which he held until his retirement only three years ago.

Margoliouth's knowledge of the Arabic language and literature was universally recognized as unrivalled in either Europe or the East. His unremitting activity in this branch of Oriental studies was devoted to the editing and elucidation of the more difficult and obscure of classical Arabic texts. Here his greatest achievement was his monumental edition of Yakut's "Dictionary of Learned Men". Next to this must be ranked his work in collaboration with H. F. Amedroz on the Abbasid chronicles of Miskawaihi. Commentators on Aristotle and the Old Testament also engaged his attention—he produced an edition of the Poetics—and he collaborated with Dean Payne Smith in the "Thesaurus Syriacus".

Those who are acquainted with Margoliouth only through his more highly specialized literary and linguistic studies may possibly fail to realize how deep and wide were his interest in and knowledge of the content of the texts he studied and, in short, of the whole range of the thought, culture and beliefs of the peoples of the Arabic tongue. His profound knowledge of the early development of Islamic belief is to be observed in some degree in his Hibbert Lectures delivered in 1913 and in the two books which appeal to a wider audience, "Mohammed and the Rise of Islam" and "Mahammedanism", the latter a volume in the Home University Library. His erudition was ever freely at the service of those whose studies lay in any cultural sphere impinging in any way upon his own, and appeal for enlightenment was never made in vain.

The Polish Government Information Department has issued a communiqué stating that up till February 1 the following professors, among others, of Polish universities have died in the concentration camp Sachsenhausen-Oranienburg, or have died since their release from camp:

Tadeusz Grabowski (philosophy);
Antoni Hoborski (mathematics);
Kazimierz Kostanecki (comparative anatomy);
Jan Nowak (geology);
Feliks Rogoziński (physiology);
Adam Różański (agricultural mechanics);
Michał Siedlecki (biology) [see NATURE, March 30, p. 492];
Jerzy Smoleński (geography);
Władysław Takliński (technology);
Antoni Wilk (astronomy);
Jan Włodek (agriculture).

We regret to announce the following deaths:

Prof. J. W. Beede, formerly professor of geology in Indiana University, an authority on the geology of Texas, on February 27, aged sixty-eight years.

Prof. Alexandre Besredka, chief of the section of microbiology of the Paris Pasteur Institute, aged seventy years.

Prof. S. M. Dixon, O.B.E., formerly professor of civil engineering in and dean of the City and Guilds College, London, on March 25, aged seventy-two years.

Mr. J. A. Hobson, the well-known economist, on April 1, aged eighty-one years.

Prof. A. E. Norton, since 1935 Gordon McKay professor of applied mechanics in Harvard University, on February 24, aged sixty-two years.

NEWS AND VIEWS

CHAIR OF CRYPTOGAMIC BOTANY AT MANCHESTER

Prof. W. H. Lang, F.R.S.

THE Barker chair of cryptogamic botany in the University of Manchester will be vacated at the end of the academic year by its present tenant, Prof. W. H. Lang. His successor has been appointed in the person of Dr. Claud Wardlaw, officer in charge of the Low Temperature Research Station at Trinidad. He is expected to take up his duties in the autumn. The founder of the Barker chair was himself an expert in the study of mosses: and his aim was to secure not merely instruction, but also general research upon those lower forms of plant life which the title of the chair connotes. In order to secure this double result, such periods of advanced teaching as are demanded from the professor are limited, thus leaving opportunity for research to him and to his pupils.

Since such conditions are exceptional, the appointment to the Barker chair commands a special interest. The distinction of its out-going occupant is well known, and was recognized by the award of a Royal Medal in 1931. Prof. Lang, having qualified in medicine in the University of Glasgow, drifted into the specialized pursuit of botanical science after having graduated with distinction also in science in 1894. In the years that followed he carried out various researches, chiefly upon archegoniate plants and gymnosperms. These marked him out as an acute experimentalist and observer, so that when the Barker chair was founded in 1909 the appointment seemed naturally to fall to him. From the first his use of observed fact was strictly critical, and his approach to constructive conclusions very guarded. These qualities are such as are specially required in palæophytology, towards which circumstances seemed to have been conspiring to guide him. For while still officially in Glasgow he had become acquainted with that prince of palæontologists, Robert Kidston, of Stirling: and was not Manchester the place where Williamson had enshrined his own peculiarly exact study of fossil plants?

After Lang's appointment to the Barker chair, the results of a happy co-operation with Kidston culminated in the five memoirs "On Old Red Sandstone Plants showing Structure, from the Rhynie Chert Bed, Aberdeenshire". Published in the *Transactions of the Royal Society of Edinburgh* (1916–1921), this series, together with that of Kidston and Gwynne-Vaughan on "The Fossil Osmundaceæ", will stand for all time as twin models of method in palæophytological research. Moreover, each deals with results of supreme importance to the comparative morphology of vascular plants. The Rhynie memoirs are perhaps the most striking record of Prof. Lang's researches. But since their completion, his laboratory has been a centre of elaboration of palæontological method, and of its application to other fossils, particularly those of very early time. He has thus laboriously gathered data which, though largely dealing with isolated facts, will ultimately take their place in the jig-saw puzzle, still very imperfectly sketched, of the earliest flora of the land.

Dr. C. W. Wardlaw

DR. C. W. WARDLAW, officer-in-charge of the Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, has been appointed to succeed Prof. Lang. Dr. Wardlaw graduated in 1921 with first-class honours in botany in the University of Glasgow and was immediately appointed assistant to the professor of botany, Prof. F. O. Bower. He carried on the Bower tradition with research on size and form in stellar structure and developed research and teaching in mycology at Glasgow. Three years later he took the Ph.D. of Glasgow and was appointed lecturer. He was sent to study mycology under Brown at the Imperial College of Science and Technology, London, and also visited Prof. Chodat's summer school in Switzerland. He took his D.Sc. degree with papers on size and form and studies on the Lanarkshire strawberry disease. He was often called in as consultant on various diseases in Scotland. In 1929 Dr. Wardlaw was appointed mycologist at the Imperial College of Tropical Agriculture, Trinidad, and undertook investigations into diseases of the banana. Later he took charge of the investigations of cold storage in particular reference to the mycological aspects, and has travelled a great deal in the West Indies and in the north of South America.

It may be thought that to appoint an expert on banana investigations as successor to so distinguished a palæontologist as Prof. Lang would be a dangerous experiment, but Dr. Wardlaw is in point of fact an all-round botanist, with a bias towards the Cryptogams. His first work was on a parasitical disease of cultivated strawberries. Then followed three searching memoirs on "Size and Internal Morphology", with illustrations, mainly cryptogamic, drawn to uniform scale. Later came a series of memoirs on the fungal diseases of the banana; and again, another series based on experiments at the Low Temperature Research Station at Trinidad. These deal with that phase of physiology which is involved in the successful transport of tropical fruits to serve the home markets. Such results, together with descriptive records of wide travel among the West Indian Islands and on the mainland of Central America, reveal Dr. Wardlaw as a botanist of broad interests, who has used his exceptional opportunities for observation and reasoning to good purpose. A botanist so versatile in what he has already accomplished may be trusted to continue the tenure of the Barker chair along lines in accord with the will of its founder.

Royal Irish Academy: New Professor of Theoretical Physics

AT the election meeting of the Royal Irish Academy in Dublin on March 16, it was announced that Dr. Erwin Schrödinger had been appointed professor of theoretical physics in the Academy as from April 1. The funds for the professorship are being supplied to the Academy by the Irish Government. Prof. Schrödinger has been giving a course of lectures on wave mechanics at University College, Dublin, since November last. This course has had a large attendance from members of the two Dublin Colleges. It will be continued now in the Royal Irish Academy.

It is believed that the institution of this professorship is intended as a temporary measure, pending the setting up of an institute for theoretical physics in Dublin, in which Prof. Schrödinger will have a permanent appointment. The recent publication of the text of a Bill making provision for the new institute shows that Mr. de Valera does not intend the financial difficulties arising out of the War situation to upset his plans for the development of higher mathematical studies. In addition to mathematics and theoretical physics, the mention of cosmology, geophysics and even chemistry in the Bill may be taken as indicating that Mr. de Valera has in mind the possibility of the institute broadening the scope of its studies in the future. There is also to be an institute for the promotion of higher Celtic studies.

Prof. H. Arctowski

WITH home, laboratory, and invaluable records of years presumably irrevocably lost during the War, Prof. Henryke Arctowski, formerly honorary professor of geophysics and meteorology in the University of Lwow, has begun work at the Smithsonian Institution on the direct effects of changes in the sun's radiation on weather conditions on the earth. Prof. Arctowski is recognized as one of the greatest authorities on world weather. He has now started with renewed enthusiasm on the correlation of solar and terrestrial phenomena from the comprehensive records of the Smithsonian Astrophysical Observatory. He has already made significant—although for the present tentative—findings of apparent cause-and-effect relationships between the variation of solar radiation and terrestrial weather conditions.

John Dixon Mann

DR. JOHN DIXON MANN, an eminent Manchester toxicologist, was born in 1840 at Kendal, where his father was borough treasurer. He received his medical education at the Manchester Royal School of Medicine and qualified M.R.C.S. and L.S.A. in 1862. For many subsequent years he was engaged in general practice in Manchester, but in 1880 he became M.R.C.P.(Lond.) as well as M.D. of St. Andrews, and confined himself to consultant practice. In 1882 he was appointed physician to the Salford Royal Hospital, and three years later became lecturer in forensic medicine and toxicology at Owens College, Manchester, in succession to Dr. C. J. Cullingworth, who was elected professor of obstetrics and gynæcology. The lectureship was converted into a chair in 1892. Dixon Mann's principal work, "Forensic Medicine and Toxicology", which won him the Swiney Prize awarded by the Royal College of Physicians of London and the Society of Arts, went through four editions between 1893 and 1907 and was for many years the standard work on the subject. His other book, entitled "On the Physiology and Pathology of the Urine with Methods for its Examination", appeared in 1904 and was followed by a second edition in 1908. He also made numerous contributions to periodical medical literature including the *Medical Chronicle*, the now extinct Manchester journal, which contains a bibliography of his writings. He died on April 6, 1912.

Hindu and Moslem in India

THE course of recent events in India tends to confirm apprehension, such as has found expression in the columns of NATURE from time to time while the terms of the new constitution were under consideration, lest the introduction of the forms of Western democracy among a population of so heterogeneous a character in culture, creed and tradition might encounter difficulties well-nigh insuperable. It was hoped by those responsible for decision that the communal solution would at once secure the rights of minorities and ensure their acquiescence in the rule of the majority which is essential for the successful working of democratic institutions. It has been made evident by subsequent events that the necessary community of outlook was lacking. This is to be seen on one side in the breakdown under provincial autonomy, on the other in the difficulty in formulating a scheme of federation in which the claims of democracy can be reconciled with the autocracy of the native States and the fears of the Princes lest they should endanger rights based upon tradition and further secured by the treaty with the British Crown.

A situation which bristles with difficulties and requires the most delicate handling has been brought within measurable distance of a crisis in the turmoil of world events. The Indian Congress, the representative body of the Hindu community, has seized the opportunity to put forward a claim for the grant of that independent status for India towards which it was hoped the new constitution would serve both as a stage and a training ground. This claim the Moslem League has countered by a demand for the recognition of separate Moslem and Hindu nations within the bounds of India. The demand is by no means so fantastic as it may appear at first. Apart from the fact that the voice of a minority of some eighty millions or more, sectional differences for once forgotten, cannot be ignored, it is based upon a very real difference in a cultural tradition, as every student of Indian civilization is aware; for the Moslem tradition fosters a democratic outlook while fearing and resenting a Hindu domination in an independent India, which would from its immemorial tradition of caste be essentially oligarchic in practice. However impracticable the Moslem demand may be, no solution will secure the future of India in world affairs or internally which attempts to ignore or override these fundamental differences of culture and tradition.

New Government Technical School at Takoradi

The opening of the new Government Technical School at Takoradi introduces a further development of this type of education in the Gold Coast. Increased demand for technical instruction necessitated the removal of the school from Accra, where the accommodation proved to be inadequate. Moreover, the new site is more favourably placed in relation to the industrialized area of the Gold Coast. The new Technical School occupies a prominent site overlooking the sea and Takoradi Harbour, and the more important buildings include a long single-story workshop with blacksmith's shop at the rear, a three-story administration block containing classrooms, laboratories, drawing offices, assembly hall and dining-room and a dormitory block capable of housing one hundred students. The workshop is in two sections, one for practical work in mechanical engineering and the other for practical woodworking. Both sections are fitted with modern electrically driven machinery such as lathes, power drills, shapers, etc., in addition to the usual benches for manual work.

Other buildings include the European housemaster's bungalow, two blocks of quarters for eight African masters, a block of six labourers' quarters, a large timber-drying store, petrol store and garage. The buildings are grouped around a five-acre sports ground. In addition, there are facilities for safe sea-bathing and boating. The buildings are fitted with electric clocks controlled by a master clock; most of the classrooms and the assembly hall are wired for the reception of wireless re-diffusion from the Sekondi broadcasting station; and there is complete water-borne sanitation. Candidates for admission must be in possession of a Standard VII Certificate or its equivalent. Present students include boys from Nigeria, Dahomey and all parts of the Gold Coast. Among entries for next year are three boys from Sierra Leone. The total cost of the scheme has been approximately £37,500, which includes approach roads, laying out of grounds, etc., the area covered by the school and grounds being some thirty acres.

Fishery Research in the Italian Empire

The rapidity of scientific development in the new Italian Empire is well illustrated by the subject of aquatic biology. Only three years have elapsed since the conquest was complete, and yet the recently formed Direzione Superiore Affari Colonizzazione e Lavoro has already set up an Ufficio Idrobiologia e Pesca at Addis Ababa, under the direction of Prof. P. Parenzan, and a considerable amount of preliminary research has taken place on the inland waters of the former Ethiopia. These are described in the first number of a new official journal entitled *Bollettino di Idrobiologia, Caccia e Pesca*. It is a well-appointed publication, containing papers on fish, their importance in the food of native peoples, parasites and pathology, and accounts of other aspects of the biology of fresh waters, including the fish-eating birds and Mollusca.

Meanwhile, in the past half century, the vastly greater areas of lakes and rivers in British eastern Africa, containing correspondingly greater resources, have been subjected only to spasmodic and short-term scientific examinations, and most of these have resulted from the initiative of individual scientific workers or institutions not immediately concerned with colonial development. Perhaps the new policy in colonial research and development which has recently been announced by the Colonial Secretary may lead, after the War, to the inclusion of fisheries in both the sea and fresh waters in a widely planned scheme of research.

Paratypical Forms in Man's Line of Descent

In a discussion, and incidentally a criticism on certain points, of the announcement of the discovery in Java of an upper jaw attributed to *Pithecanthropus erectas* (see Nature, **144**, 926; 1939), Prof. G. Montandon brings forward a suggestion which he argues would resolve certain of the difficulties inherent in apparent discrepancies in the evidence (*Rev. Scientifique*, **78**, 1; 1940), and maintains that had Dr. von Koenigswald included the palatal view of the jaw in the figures accompanying the announcement of the find, it would have been evident that Pithecanthropus stands outside the Hominidae. Prof. Montandon says that its shape is that of the U characteristic of the anthropoid jaw and not that of the horseshoe form found in man. Further, the simian diastema separating the incisors and canines is present here, though never found in man. At the same time, this disparity does not warrant classification of the jaw as that of a gibbon or other form of anthropoid. For, as Prof. Montandon goes on to point out, the teeth and especially the canines are not Simian but those of a Hominid. Comparison of the jaw with that of Sinanthropus definitely places the latter as belonging to a more advanced type and within the Hominid group.

The discussion becomes even more suggestive when Prof. Montandon passes on to consider the significance of Dr. Broom's recent discoveries in South Africa. Here in Paranthropus is a form which shows a like combination of incompatible characters. In cranial form Paranthropus is more Simian than Hominid, but at the same time in form of jaw and teeth it is the reverse. The jaw shows the horseshoe form, the absence of diastema, and a humanoid dentition. Prof. Montandon therefore goes on to ask the question, pertinent on his interpretation of the evidence, whether there may not be another form in which, as with Pithecanthropus, the cranium approaches the human more nearly than do the Paranthropoids of South Africa, but less human than them in respect of the dental arch. His further suggestion of a whole series of paratypes of wide distribution raises an interesting and wide question which at present rather hangs in the air.

Evolution Restated

THE mathematicians and physicists refer things no longer to three axes of co-ordinates, but to four, the fourth being the time axis. The world is 'four-dimensional', and is a world of *events*. This conception of time as intrinsic to things and not just something that happens to them, is applicable to the biological no less than to the physical sphere, and leads to interesting results, especially as bearing upon the theory of evolution. Some of these corollaries have been indicated by Mr. J. C. McKerrow in a pamphlet "Evolution without Natural Selection" (London: Longmans, Green and Co., Ltd.) supplementing his "Novius Organum" (1931). The Darwinian theory was that out of a number of chance or random variations a certain number were chosen by 'natural selection' to survive. The difficulty for the Darwinian has always been to account, not for 'natural selection' or survival, but for the occurrence of the variations themselves. But it is obvious that if an organism is a 'four-dimensional process' or a system of activity, an event and not a thing, it is not so much variations as repetition and sameness that call for explanation. In a world of events, things happen, whereas in a world of static fixtures, they do not.

Mr. McKerrow, like Samuel Butler, interprets organic activity (and an organism which as a four-dimensional process *is* itself an event, that is, activity, not a thing) in terms of habit. Habit accounts for sameness or stability, but it also accounts for variation, because it does not exclude freedom. "All the forces of nature that make for change are just as much available on the assumption of 'habit' as on that of mechanistic causation—with an additional element of 'fortuity' added". On this view, variations are not so much random as "manifestations of the peculiar degree of freedom of living systems". Evolution on this view is positively, not negatively, conditioned. Hypothetical variations are not produced in order to be massacred by natural selection. It is just a case of a four-dimensional Nature displaying its activity in new happenings. In any event a four-dimensional biology can scarcely leave unchanged our views of the mode of evolution.

Antimony Treatment of Kala-azar

AN article under this title by Sir Leonard Rogers appeared in NATURE of December 16, 1939, p. 1103, which presented in very bare outline the history of the use in India of antimony compounds to combat kala-azar. Sir Upendranath Brahmachari, whose work in connexion with the introduction and use of urea stibamine was referred to briefly, has submitted to NATURE a long statement surveying in some detail the work which led up to the preparation of this substance and reporting on the results obtained. He states that, contrary to Sir Leonard Rogers' statement, urea stibamine was not patented, and claims that divergent results obtained by different investigators were due to the fact that various manufacturers put on the market so-called urea stibamine which did not conform to his specification. Reference is also made to the cost of treatment with antimony compounds. Sir Leonard Rogers stated in his article that a course of treatment with urea stibamine cost £3 in 1925. In the intervening years, this has happily been reduced; Sir Upendranath states that urea stibamine is now supplied by the Government at Rs. 1 per gram, and since 1·5 gm. is sufficient for complete cure, the total cost of the drug to-day is now Rs. 1.8 (about 2*s*. 3*d*.). This is a reduction on which all who have been concerned are to be congratulated. Yet this cost is still relatively high for a country in which the great majority of the population live dangerously near the starvation line, and there is still room for a rapidly effective and really cheap remedy for kala-azar.

American Archæology and Local Research

IN view of recent references in NATURE to the stimulation of local interest in archæological research in the United States of America through Federal, National and State funds, it may be of interest to note that the Research Committee of the American Philosophical Society, in awarding grants in the natural and exact sciences from the Penrose Fund in 1938–39, allocated amounts as follows for localized anthropological and archæological investigations. These are additional to continuing grants for researches to which reference is made in another column of this issue of NATURE (see p. 558). To Emil W. Hanry, of the University of Arizona, for the excavation of a prehistoric village on Forestdale Creek, Fort Apache Indian Reservation, Arizona, an area of direct contact between the Mogollon and Anasazi cultures, 500 dollars; Margaret Lantis, University of California, for an ethnographical study of the complete seasonal round of the year of Alaskan Eskimo, 950 dollars; and Louis W. Chappell, West Virginia University, for the collection and preservation of folk-lore in West Virginia, 500 dollars. The last-named research should prove of special interest in view of its bearing upon cultural exchange between the three strains of white, Indian and Negro. The Indian in the past has suffered in both directions of over-idealization and undue depreciation arising from culture clash. The scientific study of Indian cultures by ethnographical and archæological methods is rapidly widening appreciation in truer perspective.

History of Artificial Eyes

THE January issue of the *Annals of Medical History* contains an interesting account, accompanied by numerous illustrations, of the ancient origins of artificial eyes by Dr. Gordon M. Bruce, of New York. The earliest artificial eyes about which there is definite information were made in Egypt for the adornment of mummies, mummy masks and statues, of which many varieties are to be seen in museums. Artificial eyes have also been found in Aztec and Inca mummies, as well as in mummified specimens from Darnley Island in the Torres Strait and the Solomon Islands. The ancient Syrians were familiar with the use of artificial eyes, as is shown by a specimen in the Metropolitan Museum of New York. The existence of artificial eyes in Babylonian times has recently been proved by the discovery of a cuneiform inscription of about 1600 B.C., in which 22 artificial eyes, 9 of agate and 13 of chalcedony, are mentioned. In ancient Greece statues were often provided with artificial eyes, Pheidias's statue of Athena being a celebrated example. In ancient Rome the *faber ocularius*, or maker of artificial eyes, existed as well as the *medicus ocularius*, who was a favourite subject for contemporary satirists, especially Martial. There is no definite description of artificial eyes to replace those lost by disease or accident before the middle of the sixteenth century, when they are mentioned by Ambroise Paré, but, as Dr. Bruce points out, the terms in which he speaks of them do not indicate that they were an innovation at that time.

The Development Commission

THE twenty-ninth report of the Development Commissioners, for the year ending March 31, 1939, has just been published (H.M. Stationery Office. 2*s*.). The total sum recommended for the fund was £625,642, of which agriculture and rural industries accounted for £579,480, and fisheries and harbours £46,162. These grants, particularly in the latter case, were rather smaller than in the previous year, when the amounts were £608,911 and £131,555 respectively. A short section describes the subject of study, size of staff and total sums available for expenditure at each of the agricultural research institutes in receipt of grants from the Fund, but details of their work are supplied in other publications. Results accruing from grants are necessarily difficult to assess, but it must be remembered that it is largely through her research institutes that Great Britain maintains such a close touch with agricultural science throughout the world, and has been able to assist in Empire development through supplying trained men.

As regards rural industries, the greater part of the sum allocated has taken the form of grants to the Rural Industries Bureau. The latter exists both to help the craftsmen for their own sakes and to maintain the village workshop for the sake of the country. By its advisory service and the introduction of improved equipment and methods of business it is hoped to secure the interest of the younger generation in industries of vital importance to the farmer. Investigations undertaken by the Fishery Departments are largely carried out under schemes adopted by the International Council for the Exploration of the Sea. Both the English and Scottish share of the investigations receive support from the Fund, and grants have also been made for research on freshwater fisheries.

Colorimetry of Electric Discharge Lamps

IT is claimed in the *G.E.C. Journal* of February that during last year very satisfactory progress was made in developing various types of technique for improving electric discharge lamps. Unsolved problems in heterochromatic photometry and colorimetry previously stood in the way. The problem was complicated by the practical application of fluorescent discharge lamps to domestic and other forms of interior lighting. This made it necessary to measure the colour-rendering properties of the light sources in a way distinct from their colour. Although non-selectively reflecting surfaces or fabrics, such as 'whites' or 'greys', will have the same coloured appearances when illuminated by light from such sources, since reflection by these surfaces produces no change in the spectral energy distribution of the light, the coloured appearance of selectively reflecting surfaces, such as dyed fabrics, may be quite different. Therefore, although the colour of these two light sources is the same, their colour-rendering properties are different, and it is this latter property which it is desired to measure.

Two types of measurement are made: (*a*) the determination of the most desirable colour-rendering properties of light sources when performing different tasks at different illuminations (this involves major research into chromaticity scales under different observational conditions); (*b*) the recording of the spectral luminosity distribution of light sources already established as satisfactory for particular purposes, so that the manufacture of such lamps can be controlled in a manner to ensure uniformity of colour-rendering properties of the commercial lamps or fittings. These measurements are carried out by visual photometric measurements of spectral luminosity made, in turn, through a series of spectral filters which transmit light only within defined wavelength limits. This involves a comparatively simple technique which can be undertaken commercially with photometric apparatus. For differentiating and defining the colour-rendering properties of many electric discharge lamps, this method is not sufficiently sensitive. One recent method, which is being used to define the luminosity distribution throughout the spectrum, utilizes physical photometric methods of measuring the relative luminosity in eight suitably chosen adjacent spectral bands, extending throughout the physical spectrum.

Trench Fever

IN his inaugural thesis (*Thèse de Paris*, No. 870; 1939), Dr. Robert Schapiro remarks that since the War of 1914–18, during which trench fever was very prevalent both on the French and Italian fronts as well as in Salonica and Mesopotamia, endemic cases have been reported in the south of France and Russia. It is also probable that many cases have passed unrecognized. Reports received from Spanish doctors living in their own country or as refugees in France indicate that there has been an outbreak of the disease in Spain, although Schapiro has been unable to obtain confirmation of this from other sources. The possibility, however, of a return of the disease must be recognized in view of the fact that defective hygienic conditions, and particularly the presence of lice among the troops, favour the spread of trench fever.

Moreover, the risk of its occurrence is increased by the transfer last autumn of German troops from east to west, as the disease is undoubtedly more prevalent in Central Europe than in the west. Soldiers, however, are not the only persons liable to contract the disease, although they were chiefly affected during the Great War, but owing to the contacts between the army and the civil population the latter are also liable to become infected, especially in the case of large agglomerations and refugees. Although trench fever is not a serious disease in itself, it may be the cause of a considerable degree of invalidism, as is shown by the fact that Sir Wilmot Herringham calculated at eight million the total number of days off duty in the British Army due to this cause. Prevention consists in immediate isolation of the first cases, delousing of contacts and other methods for the destruction of lice.

Miniature Circuit-Breakers

THE *Electrical Review* of March 29 points out that an amendment has been made by the Standards Association of Australia to its wiring rules, by a provision that the loading of final sub-circuits may be increased if sealed circuit-breakers of an approved type are used in place of fuses. In this case two general purpose socket outlets in a room of a dwelling-house can be counted as one if connected with an 8, 12 or 18 ampere final sub-circuit, and any permanently connected appliance rated at 100 watts or less may be counted as a lighting point. It is stated that in many cases the additional cost of the circuit-breaker will be largely offset by the reduction in the number of fuses required. While the Wiring Rules of the Standards Association of Australia differ materially from the Regulations of the Institution of Electrical Engineers, thus precluding the possibility of direct comparison, the value of a circuit-breaker the setting of which cannot be tampered with would in many cases be high.

The Science Masters' Association

THE report for 1939 of the Science Masters' Association records a rapid growth in membership. Last year no fewer than 914 schools were represented, whereas twenty years ago there were only 143. So extensive a combination can produce effective action, which we notice in the first annual report of the London and Home Counties Branch. Suggestions on the new physics syllabus of the London General School Examination were made after discussion, sent to the general committee of the Association, passed on, and accepted. The result is changes which are announced to "take effect in the physics paper at the next examination".

Memorandum on Scabies

SCABIES, or the 'itch', is a superficial inflammation of the skin caused by infestation with the itch mite, the female of which burrows into the skin producing much irritation. The affection is very liable to occur among collections of persons living together in restricted circumstances such as are met with in war-time, among evacuee children, soldiers and others. The Ministry of Health has therefore issued a useful memorandum on the subject (Memo. 229/Med. H.M. Stationery Office. 2*d*. net). It describes the affection and its complications, diagnosis, methods of spread and prevention, and the treatment.

The Iron and Steel Institute

MR. JOHN CRAIG, chairman and managing director of Messrs. Colvilles, Ltd., has been elected president of the Iron and Steel Institute for the next two years. Mr. Craig will be inducted into the presidential chair by the retiring president, Lord Dudley, at the annual general meeting on May 2. The Bessemer Gold Medal for 1940 of the Institute has been awarded to Dr. Andrew McCance, of Glasgow, in recognition of his eminent services in connexion with the application of science to the iron and steel industry. Dr. McCance is a director and general manager of Messrs. Colvilles, Ltd. M. Eugène Schneider has been nominated an honorary member to celebrate the fiftieth anniversary of his election to membership. M. Schneider joined the Institute in 1890 and was president for the period 1918–20. An Andrew Carnegie Silver Medal has been awarded to Mr. Bo W. L. Ljunggren for his memoir entitled "Method of Sclero-grating employed for the Study of Grain Boundaries and of Nitrided Cases; Grain Structures revealed by Cutting". The Williams Prize for 1939 has been divided between Mr. W. B. Lawrie, for his paper on "The Refining of Metal in the Basic Open-Hearth Furnace. The Influence of Fluorspar on the Process", and Mr. W. T. Wilson, for his paper on "The Rolling of Sections at the Appleby-Frodingham Steel Company, Limited." No papers have been received in competition for the Ablett Prize for a paper on a subject connected with engineering in iron and steel works written by a junior engineer. Captain Ablett has renewed the offer of the Prize for competition in 1941. Particulars can be obtained from the Secretary of the Institute; papers must be submitted not later than January 31, 1941.

Announcements

THE annual joint meeting of the Institute of Radio Engineers and the American Section of the International Scientific Radio Union will be held at the National Academy of Sciences, Washington, D.C., on April 26. A programme of abstracts will be available in booklet form about April 15. Correspondence should be addressed to S. S. Kirby, National Bureau of Standards, Washington, D.C.

A RESEARCH department for racial hygiene has recently been created in the Welfare Ministry in Japan. It is preparing a new law on marriage and sterilization.

ACCORDING to the United States National Health Survey the prevalence of blindness is greater among men than among women. For every one hundred blind women, one hundred and eleven men were affected. Nearly twice as much blindness was found among coloured people as among white.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Notes on points in some of this week's letters appear on p. 554. Correspondents are invited to attach similar summaries to their communications.

The Mass of the Universe

I find certain difficulties in connexion with the mass of the universe considered as a finite sphere of radius $4{\cdot}9 \times 10^{23}$ miles and of volume $5{\cdot}2 \times 10^{71}$ cubic miles. Eddington gives the mass of the universe as 10^{22} stars averaging our sun in weight. Taking $2{\cdot}0 \times 10^{27}$ tons as the sun's weight, then the mass of the universe would be $2{\cdot}0 \times 10^{49}$ tons. There are, says Eddington, $1{\cdot}575 \times 10^{79}$ electrons and an equal number of protons in the universe. Assuming the mass of these units to be respectively $9{\cdot}038 \times 10^{-28}$ gm. and $1{\cdot}65 \times 10^{-24}$ gm., then the weight of the electrons must be $1{\cdot}4235 \times 10^{52}$ gm. and that of the protons $2{\cdot}598 \times 10^{55}$ gm.; their combined masses would amount to $2{\cdot}599 \times 10^{55}$ gm. or $2{\cdot}55 \times 10^{49}$ tons, which is a fairly close approximation to the weight of the universe calculated on the basis of stars.

But is not this mass, of the order of $2{\cdot}0 \times 10^{49}$ tons, too low? It would appear to leave out of account the mass of the radiations (photons) that are being poured out by luminous stars into practically every nook and corner of the $5{\cdot}2 \times 10^{71}$ cubic miles of space. Our own sun, we are told, is losing $4{\cdot}0 \times 10^{6}$ tons of matter every second while emitting in the same period of time an equivalent of energy, $3{\cdot}8 \times 10^{33}$ ergs. As the sun is an average representative of the stellar bodies, it follows that the totality of 10^{22} stars comprising the universe is losing $4{\cdot}0 \times 10^{28}$ tons of matter per second, and is emitting in the same time $3{\cdot}8 \times 10^{55}$ ergs.

Hubble, taking a shorter radius ($8{\cdot}23 \times 10^{23}$ miles) and a smaller volume ($1{\cdot}92 \times 10^{63}$ cubic miles) of the universe, gives his estimate of its mean density as $1{\cdot}5 \times 10^{-31}$ gm. of matter per cubic centimetre, that is, about a gram to every $6{\cdot}6 \times 10^{30}$ cm.^{3}, or in more homely weights and measures, about a pound mass in every $7{\cdot}2 \times 10^{17}$ cubic miles. Apart from the energy-equivalent of the matter in space (say $4{\cdot}08 \times 10^{23}$ ergs per pound), what is the mean quantity of the energy of radiations (photons) per unit volume—a cubic centimetre or a cubic mile—of space? Would not the mass of this, added to that of matter, afford a more trustworthy basis for calculating the total mass of the cosmos than a basis which takes into consideration matter alone?

Charles M. Beadnell.

Hollywood,
Egham,
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Undoubtedly, the mass of the radiation should be added to the mass of the stars and of the nebulous matter in computing the total mass of the universe. But the general belief is that its contribution is comparatively small—less than 1 per cent of the whole. This is not inconsistent with the figures cited by Admiral Beadnell. With radiation at the rate of 4×10^{28} tons per second, it would take 5×10^{18} seconds, or more than 10^{11} years, to accumulate to 1 per cent of the total mass 2×10^{49} tons. According to cosmological theory, the age of the stars can scarcely exceed 10^{10} years.

Perhaps Admiral Beadnell was thinking in terms of a former time-scale, based on the hypothesis of mutual annihilation of protons and electrons, which allowed an age of 10^{13} years or more. Owing to the discovery of the positron, neutron, etc., this hypothesis (always very dubious) has, I think, no adherents to-day. According to present theories, the source of a star's radiant energy is the transmutation of hydrogen into other elements. This means that less than 1 per cent of the mass of the universe has been, or ever can be converted into radiation. It may be noted that when the mass of the universe is computed from the total number of protons and electrons, no correction for the mass of the radiation is required, since it merely compensates the mass-defect of the nuclei formed by the transmutation.

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Turnover Rate of Nucleic Acid

Caspersson's work[1] on the nucleic acid metabolism suggests that an appreciable turnover of the nucleic acid present in the nuclei of tissue cells may take place. This fact induced us to determine the rate of turnover of nucleic acid extracted from various organs of rabbits by making use of the method of isotopic indicators applied previously to determine the turnover rate of various other phosphorus compounds.

The labelled sodium phosphate used as indicator was administered all through the experiment in order to keep the activity of the plasma inorganic phosphorus at a constant level. After the lapse of a few hours or days, the nucleic acid was extracted from some of the organs. A slightly modified form of Hammarsten's method[2] was used. The turnover figures, recorded in Tables 1 and 2, were obtained by comparing the specific activity (activity per mgm. phosphorus) of the nucleic acid phosphorus extracted at the end of the experiment with the average specific activity of the cellular inorganic phosphorus which prevailed during the experiment. The value of the activity of the cellular inorganic phosphorus is obtained from that of the tissue inorganic phosphorus after subtracting the share due to the extracellular space of the tissue. The specific activity of the inorganic phosphorus present in the interspaces is

TABLE 1.
TURNOVER OF NUCLEIC ACID IN THE COURSE OF 11·5 HOURS. WEIGHT OF THE RABBIT: 2·4 KGM.

Fraction	Specific activity	Percentage renewed during the experiment
Liver inorganic P at the end of the experiment	100	
Liver cellular inorganic P average during the experiment	69·5	
Liver nucleic acid P	4·0	5·7
Muscle inorganic P at the end of the experiment	18·2	
Muscle cellular inorganic P average during the experiment	10·2	
Muscle nucleic acid P	1·4	13·7
Thymus inorganic P at the end of the experiment	90	
Thymus cellular inorganic P average during the experiment	63	
Thymus nucleic acid P*	3·8	6

* In an experiment lasting 4 hours, the specific activity of the thymus nucleic acid was found to be 2·8 per cent of that of the plasma inorganic phosphorus.

taken to be equal to the specific activity of the plasma inorganic phosphorus. The latter is found, after 4 hours for example, to be 2·5 times as large as the specific activity of the liver inorganic phosphorus. From this figure, and the result obtained that from 100 inorganic phosphorus atoms present in the tissue 3 are located in the interspaces, it follows that from 100 activity units present in the tissue 8 are located in the interspaces and, thus, the specific activity of the cellular inorganic phosphorus at the end of the experiment is equal to 92/97 of that of the tissue inorganic phosphorus. As we have determined the change of the specific activity of the tissue inorganic phosphorus with time, we can calculate the average value of the specific activity of the cellular inorganic phosphorus prevailing during the experiment.

In experiments in which all the labelled phosphate was administered to rats at the start, we found, after the lapse of 24 hours, the specific activity of the liver nucleic acid phosphorus to amount to 28 per cent of the specific activity of the liver phosphatide phosphorus. In a laying hen, after the lapse of 5 hours, the corresponding figure was found to be only 5 per cent.

As seen in Tables 1 and 2, an appreciable turnover of the nucleic acid takes place in all the organs investigated. While, however, all other organic phosphorus compounds present in the liver were found by us to be entirely renewed in the course of a few days, as long as after the lapse of 50 days two thirds of the nucleic acid molecules present in this organ were found to be unchanged. In the muscles, on the other hand, the turnover of the average nucleic acid molecule is more rapid than in the liver or in the thymus. In the brain the turnover rate of the nucleic acid was found to be markedly lower than that of the phosphatides.

TABLE 2.
TURNOVER OF NUCLEIC ACID IN THE COURSE OF 50 DAYS. WEIGHT OF THE RABBIT: 2·5 KGM.

Fraction	Percentage renewed during the experiment
Liver phosphatide P	100
Liver nucleic acid P	33
Muscle phosphatide P	73
Muscle nucleic acid P	93
Brain phosphatide P	77
Brain nucleic acid P	27

All the above data are calculated on the assumption that the inorganic phosphorus atoms incorporated into the newly formed nucleic acid molecules have the same specific activity as the average cellular inorganic phosphorus. It is possible that the penetration of inorganic phosphorus into the nuclei is a slow process and that, correspondingly, the formation of labelled nucleic acid molecules inside the nuclei took place with the participation of phosphorus atoms less active than the average cellular phosphorus. In that case the turnover figures recorded in Table 1 do not represent the proper turnover rates but only their lower limit, and the actual turnover rate of the nucleic acid is still greater than stated above.

In experiments *in vitro*, no exchange was found between the phosphorus of the nucleic acid and that of sodium phosphate, as was to be expected. 100 mgm. thymonucleic acid, kindly presented to us by Prof. Hammarsten, were dissolved in 4 c.c. water, and 0·01 gm. labelled phosphorus as sodium phosphate was added. After shaking the solution for 1 hour, the nucleic acid was precipitated by adding an excess of 1/3 *N* alcoholic hydrogen chloride solution. The precipitate contained only a minute activity. We conclude that less than 1/4000 of the nucleic acid phosphorus was replaced by labelled phosphorus.

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[1] Caspersson, T., *Skand. Arch. Physiol.*, Suppl. to **73** (1936).

[2] Hammarsten, E., *Biochem. Z.*, **144**, 383 (1924).

Thermal Expansion of Invar

It is well known that invar possesses a coefficient of linear expansion which is much smaller than those of other metals, and that measurement of its expansion over a restricted range in the region of room temperature is a matter of some difficulty. It is therefore thought worth while to direct attention to a method of measuring the coefficient of expansion which is very unusual in that it is unnecessary to know the length of the rod the coefficient of which it is desired to measure.

Joule[1] showed that when a longitudinal tension of F dynes is suddenly applied to a metal rod, there results an adiabatic change of energy $\triangle E$, resulting in a fall of temperature $\triangle T$, given by $\triangle E = J\rho.s.\triangle T = \alpha TF/A$, where α is the coefficient of linear expansion, T is the absolute temperature, J the mechanical equivalent of heat, and ρ, s and A are respectively the density, specific heat and area of cross-section of the rod. It is seen that the quantity $J\rho.s$ is the number of ergs per c.c. which must be imparted to the rod to raise its temperature by 1° C.

Now, invar is ferromagnetic, and, by taking the rod round one half of a hysteresis cycle, a quantity of energy $\triangle E'$ equal to $\int_{-H}^{+H} HdI$, is liberated as heat; this produces a rise in temperature $\triangle T'$ given by $\triangle E' = J\rho.s.\triangle T' = \int_{-H}^{+H} HdI$. If, therefore, we can measure $\triangle T$ and $\triangle T'$, and can calculate $\int_{-H}^{+H} HdI$ from magnetic data, we know α, since it is equal to

$$\frac{\triangle T}{\triangle T'} \cdot \frac{A}{T.F.} \int_{-H}^{+H} HdI.$$

In a recent letter in NATURE[2], we mentioned a new method of measuring the heat generated step by step in a hysteresis cycle. We have now applied this method to an invar rod 0·473 cm. in diameter, purchased from Messrs G. P. Wall, Sheffield. We find that at 7·6° C., the temperature within our cooled solenoid, the calculated value of $\int_{-190}^{+190} HdI$ is 2,984 ergs per c.c., which gives a total deflection of 0·91 cm. with our temperature measuring device. The sudden application of a longitudinal tension of 36·75 kgm. to the rod results in a deflection of 7·21 cm. The ratio $\triangle T/\triangle T'$ is therefore equal to 7·92 and $\alpha = 0{\cdot}411 \times 10^6$ per degree C., correct, in our view, to less than 2 per cent.

Unfortunately, no specimen of superinvar[3] (63·5 iron, 32·5 nickel and 4 cobalt) is at our disposal, but we see no reason why its coefficient of linear expansion should not be obtained in the same way. The method as described above is applicable to ferromagnetic substances only, but it could be modified to deal with non-ferromagnetic materials.

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[1] Joule, J. P., "Collected Works", **1**, 426; *Phys. Soc. Lond.*, 1884.
[2] Bates, L. F., and Weston, J. C., NATURE, **145**, 188 (1940).
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Liberation of Potassium from Muscle by Acetylcholine

POTASSIUM appears to increase the liberation of acetylcholine from frog's heart (Beznak[1]), from the superior cervical ganglion (Brown and Feldberg[2,3]) and from other organs (Feldberg and Guimarais[4]). But it has been found[5,6] that muscles curarized with erythrina, cobra venom, curare, etc., are nearly or completely insensitive to intra-arterial injections of acetylcholine, whereas they react normally to potassium. It may therefore be inferred that if both compounds intervene in the nervous transmission, acetylcholine acts by the intermediate liberation of potassium probably from some organic compound as suggested by Reginster[7] for striated muscles, and Dulière and Loewi[8] for the central nervous system of the frog.

If the sciatic artery of a toad is perfused with potassium-free Ringer solution containing acetylcholine at a concentration of 1×10^{-6} or more, the contracture of the muscles is accompanied by an increase in the concentration of potassium in the liquid flowing from the vein.

Denervated muscles which respond more readily to acetylcholine liberate ten times more potassium than normal muscles, and curarized muscles which do not react to acetylcholine liberate no potassium.

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[2] Brown, C. L., and Feldberg, W., *J. Physiol.*, **84**, 12P (1935).
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[6] Cicardo, V. H., *Rev. Soc. Arg. Biol.*, **15**, 12 (1939).
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Relationship between the Critical Temperatures, Boiling Points and the Parachor Values of Simple Molecules

IN previous publications[1,2], it has been pointed out that the critical temperatures and boiling points of chemically related substances containing the same number of molecules are linear functions of the parachor values P, and the van der Waals factor b has been shown to be similarly related. It was suggested that the applicability of such a relation to a distinct series was probably due to the similarity of cohesional and configurational functions characterizing a particular group. Recently, an interesting regularity was observed which gives considerable support to this suggestion.

The simple electronic conception of valency pictures the combination of atoms as being due to the preferential arrangements of the outermost electronic sheaths, but the factors giving rise to the known cohesive force which exists between neutral molecules are still a matter of conjecture. It is extremely probable that this cohesive force is governed to a large extent by the arrangement of electrons around the neutral molecules taken as a whole, and that the major part of the cohesive effect is exerted by those electrons which do not participate in a true 'valency bond'. Thus, a consideration of the following molecular types readily gives n, the number of electrons exerting a 'cohesive effect'.

Type	Inert Gas	Halogen acid	Halogen
	$:\overset{..}{\underset{..}{\mathrm{Ne}}}:$	$\mathrm{H}\,\overset{\times}{\underset{\times}{}}\,\overset{..}{\underset{..}{\mathrm{Cl}}}:$	$:\overset{..}{\underset{..}{\mathrm{Cl}}}\,\overset{\times}{\underset{\times}{}}\,\overset{..}{\underset{..}{\mathrm{Cl}}}:$
n	8	6	12

The following table gives the derived equations for the critical temperatures taken from the original paper[1]. It is remarkable that in each case the coefficient of P when divided by the function n gives an almost constant result.

Group	Equation	k (coeff. of P)	n	k/n
Inert gas	$T_c = 3{\cdot}7P - 48$	3·7	8	0·465
Halogen acid	$T_c = 2{\cdot}72P + 130$	2·72	6	0·453
Halogen	$T_c = 5{\cdot}57P - 188$	5·57	12	0·465

A similar regularity exists when the boiling point/parachor equations for a distinct series are considered, and it seems to show that the electrons in a molecule which do not participate in chemical bond formation play an important part in determining the magnitudes of the physical constants.

It is apparent that the general equation, $T_c = 0{\cdot}465\, nP + \text{const.}$ will apply to all the above types of molecules, where n has the previous significance.

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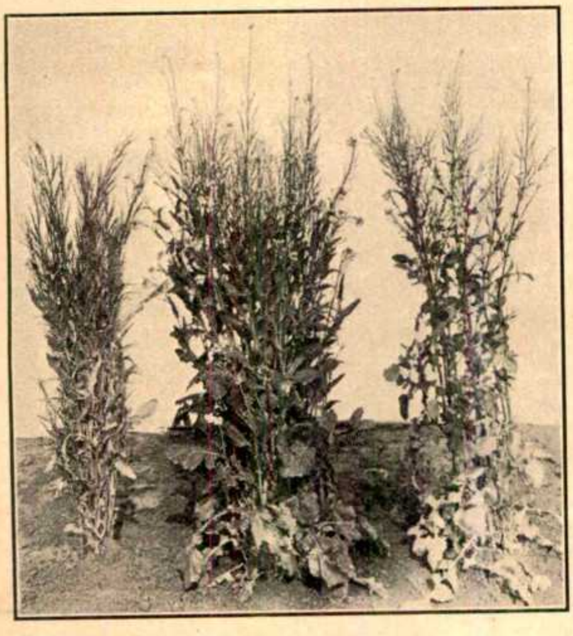
[1] *J. Chem. Soc.*, 263 (1938).

[2] *J. Chem. Soc.*, 1058 (1938).

An Apetalous Mutation in Turnip (*Brassica campestris* L.)

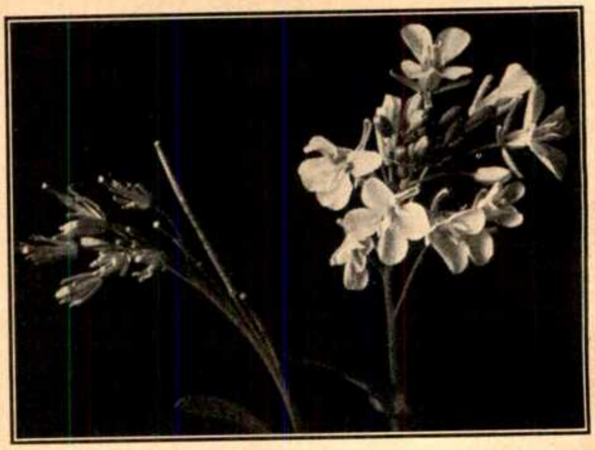
DURING the year 1938–39 a stray plant of Brassica was discovered, in a lucerne field, which looked strikingly different from any of the plants in the very extensive collection of oleiferous Brassicas which were being grown for cytogenetic study. An examination of this erect, compact plant showed that the flowers were devoid of the bright yellow petals characteristic of the genus and that this was the reason for its peculiar appearance. A number of unopened buds were dissected and examined and in every case it was found that the stamens were inserted immediately after the sepals, the whorl of petals being absent. Seed-setting was excellent under conditions of both self- and open-pollination. The chromosome number of the plant was determined at pollen meiosis as $n = 10$, that is, the same as in ordinary turnip, which it closely resembled in morphological characters.

Crosses between the apetalous plant and turnip were made reciprocally, seed-setting in both cases being quite normal. During the current season the crossed, selfed and open-pollinated seeds of the plant were sown. The seeds from the apetalous plant (both selfed and open-pollinated) gave rise to apetalous plants resembling the parent, whilst the crossed seeds gave rise to hybrids which had petals like the turnip parent. Fig. 1 shows the parents and the hybrid and Fig. 2 is a close-up view of the flowers of the apetalous and turnip parents. It is clear from the data above that the apetalous character is heritable and recessive to the petalled condition.



Apetalous form   Hybrid   Turnip

Fig. 1.



Apetalous form   Turnip

Fig. 2.

There is no previous record, so far as I am aware, of the occurrence of any variety in which an apetalous condition is inherited. The only comparable case in literature is that in maize, in which Sprague[1] has reported a mutation in which the glumes were suppressed and the anthers consequently exposed. This mutation in maize is dominant, while in the present case the absence of petals is a recessive character. It is probable that this apetalous plant also arose as a mutation.

The importance of this mutation lies in its possible practical application. Many oleiferous Brassicas are self-sterile and new varieties evolve by mass selection or otherwise rapidly degenerate when grown in the field, owing to cross-pollination. Even if self-fertile forms are obtained, the maintenance of purity of the stocks and their further improvement presents a problem because of the extensive cross-pollination which still goes on. The apetalous plant, however, is not only self-fertile but also self-pollinating and provides an easy means of detecting the hybrids resulting from outcrosses, in its progeny, as such hybrids will possess petals and stand out conspicuously among the apetalous plants. Thus heterozygous plants can be easily rogued and the purity of the strain maintained. Furthermore, the apetalous character, being recessive, can easily be bred into other strains.

As regards the extent of cross-pollination occurring in this plant, it is noteworthy that out of about a hundred plants raised from the seed of the original plant, not a single hybrid was obtained. Preliminary observations this season also show that the amount of cross-pollination must be very low. One row of the apetalous plants was grown between rows of normal plants and daily observations were made of the numbers of visiting insect pollinators.

It was found that these pollinators (chiefly bees) showed a decided preference for the petalled plants and flew over from one row of these to another, neglecting the apetalous plants growing in between.

Studies of the genetics of the apetalous character and its usefulness for practical breeding are in progress.

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[1] Sprague, G. F., *J. Hered.*, **30**, 143–45 (1939).

Relationship of *Gossypium Raimondii* Ulbr.

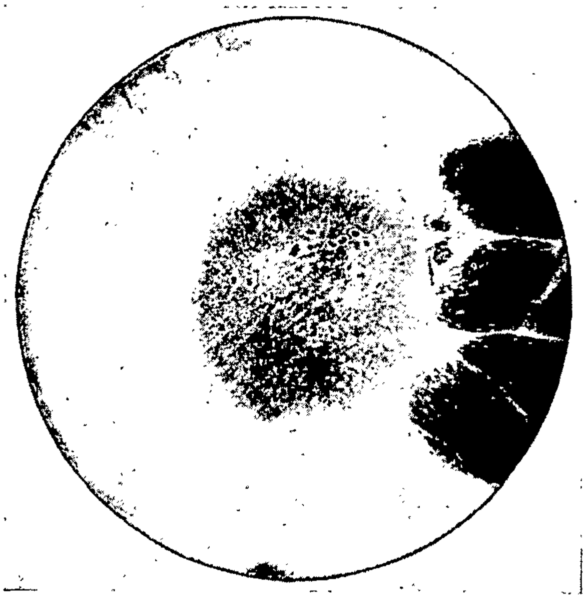
Two notes have recently appeared on the relationship of the wild Peruvian species of cotton *Gossypium Raimondii*, Ulbr.: Hutchinson[1] and Newcombe[2] simultaneously grouped *G. Raimondii* with $2n = 26$ wild New World cottons on somatic counts made by Madoo. They placed it in the sub-group *G. Koltzschianum*, Anderss, *G. Davidsonii*, Kellogg, which it undoubtedly resembles morphologically, the former adding hybridization behaviour.

At La Molina, the chromosome conjugation of *G. Raimondii* at meiosis has shown thirteen bivalents.

In a cross *G. hirsutum*, L. (*U*4) × *G. Raimondii* the meiotic chromosome conjugation shows a mean of 12·57 univalents, 11·65 bivalents, 0·87 trivalents, and 0·125 quadrivalents, and a chiasma frequency of 1·62 per bivalent.

From this data it is suggested that *G. Raimondii* is more closely related to *G. armourianum*, Kearney, *G. trilobum* (*DC*) Kearney, *G. Harknessii*, Brandg., and *G. aridum*, Skovsted, than to *G. Davidsonii*, Kellogg and *G. Klotzschianum*, Anderss.

The accompanying photomicrograph of the conjugation in the hybrid *G. hirsutum* × *G. Raimondii* shows twelve univalents and most of the bivalents.



× c. 1000.

A more detailed study is being put out as an official publication of La Molina Agricultural Experimental Station.

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[2] Newcombe, H. B., *J. Hered.*, 30–12, 530 (1939).

Use of Adsorption Processes for the Detection of "Traces"

METHODS for the detection of a trace of a compound dissolved in water may be made very sensitive if that compound can be concentrated by adsorption at an interface. Thus an almost infinitesimal quantity of grease, adsorbed on a metal or mineral surface, is readily detected by its effect on the displacement of water from that surface by air[1]. Very sensitive tests for copper, lead and cyanide ions were also discovered in the course of an investigation of the basic principles of the flotation process. Though these are not specific, they seem worth recording in illustration of a method that may sometimes be useful.

When a mineral is polished out of contact with air, there is produced a surface from which air is unable to displace water[2]. A pyrite (FeS_2) surface prepared in this way becomes air-avid in a 25 mgm. per litre solution of potassium ethyl xanthate, as a bubble of air pressed against the surface will now adhere to it. One part of CN^- in 2×10^7 parts of water prevents this adhesion.

Sphalerite (ZnS), polished similarly, does not respond to this concentration of xanthate even in the absence of cyanide. However, if there is present 0·006 mgm. lead nitrate per litre as well as the xanthate, the surface does become air-avid, the lead ions acting as a link between the mineral surface and the xanthate ions. Likewise, 0·005 mgm. copper sulphate ($CuSO_4.5H_2O$) per litre induces air-avidity in the presence of sodium di-ethyl dithiocarbamate. Thus one part of lead in 3×10^8 parts of water and one part of copper in 8×10^8 parts of water are detectable. For copper the test is ten times as sensitive as the usual dithiocarbamate test[3].

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Jan. 11.

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Angle of Repose of Snow on Solids

IT is well known that the friction of solids on snow surfaces is larger than on ice surfaces. The higher kinetic friction obtained on snow is attributed to the extra work done in displacing and compressing the snow crystals[1]. This may apply to the sliding of a ski or a sleigh on snow. It is, however, common experience that snow also while resting, for example, on the roof of a house or on a metal spade, exhibits a considerable angle of repose.

The extremely small friction of ice surfaces near the melting point is due to lubrication by water at the points of contact between the sliding surfaces. The porosity of snow hinders considerably the establishment of thick film lubrication by the melt. This is demonstrated by the following experiments. The angle of repose of snow and of snow compressed by hand was measured on various surfaces which were at room temperature (about 20° C.). The compressed snow always has the smaller angle of repose (see accompanying table). The 'loose' snow sticks on steel even at an angle of inclination of 90°, while the molten water rises in the snow 'capillaries'.

Base plate	Angle of repose		Coefficient of static friction	
	Loose snow	Compressed snow	Loose snow	Compressed snow
Smooth bakelite	16°	3°	0·29	0·05
Glass	19°	3°	0·34	0·05
Ferrotype	16°	7°	0·29	0·12
Steel	>90°	35°	∞	0·7

The blotting action of the snow, which leaves, in contradistinction to the non-porous ice, at first only a thin adhesive intermediary water film, particularly when melting proceeds more rapidly from the solid base (for example, steel) than from the surrounding air, might become more obvious in an experiment where melting is not involved. A small heap of silica powder flows from a dry glass plate at a small angle of inclination. Addition of a sufficiently small amount of water just to wet the sand heap cements its grains together and cements the sand heap to the glass plate. It sticks to it, even at an angle of inclination of 90°. However, an addition of water, in excess of saturating the sand heap with it, leads to thick film lubrication and makes the sand slide off the glass plate at a small angle of inclination.

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[1] Bowden, F. P., and Hughes, T. P., *Proc. Roy. Soc.*, A, **172**, 263 (1939).

Snowfall in the Winter of 1939-40

WHEREAS the great ice-storm which affected a large area in western and southern England on the night of January 27 has been stressed in the various reports which have hitherto appeared on the cold weather, the magnitude of the snowfall seems to have been under-estimated.

Apart from various other snowfalls, there occurred on the very night of the ice-storm an exceedingly heavy fall of dry drifting snow over the whole of south-eastern, eastern, midland and northern England, as well as most of Scotland. In Kent, the Chilterns and East Anglia, the fall on the level was commonly between 1 ft. and 2 ft., and many villages were isolated by huge drifts ; in Lancashire, Cheshire and the Lake District the general fall was between 2 ft. and 3 ft. The fall on the Lancashire coastal plain was apparently the heaviest since February 1900. It is possible, and indeed suspected, that part of the accumulation may have been due to mass drifting from the Pennine uplands to eastward.

The late Mr. Joseph Baxendell, formerly superintendent of the Southport Borough Observatory, has frequently of recent years written to me respecting the scarcity of serious snowfall in west Lancashire, and I cannot but regret that he was not spared quite long enough to see this mighty downfall of snow.

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Points from Foregoing Letters

THE method of isotopic indicators has been used by L. Hahn and G. Hevesy to determine the rate of turnover of nucleic acid extracted from various organs of rabbits. The rate of exchange is extremely low in the liver ; it is higher in the thymus and in the muscles.

L. F. Bates and J. C. Weston show that the coefficient of thermal expansion of invar may be determined by measuring the changes of temperature which occur when a rod is suddenly stretched and when it is taken through a hysteresis cycle.

It has previously been assumed that the linear relationship existing between the parachor and critical temperatures of chemically related substances is due to similarity of cohesive effect. D. T. Lewis finds that the slopes of these lines vary in a simple manner with the number of electrons in simple molecules which do not participate in the true 'valency bond', and this is put forward by him as evidence that these electrons play a large part in determining the magnitude of the cohesive forces between molecule and molecule.

K. L. Sutherland describes effects on mineral surfaces due to minute traces of copper, lead and cyanide ions. It is pointed out that traces are more readily detected when they have been concentrated by adsorption at an interface.

S. Ramanujam describes an apetalous mutation of the turnip, with $n = 10$, which is the normal number. By crossing with the normal petalled form, the author has shown that the apetalous character is heritable but recessive.

The kinetic friction of solids is higher on snow than on ice, partly on account of the extra work done in displacing and compressing the snow crystals. R. Schnurmann finds the static friction of snow on solids at room temperature still higher, because the porous snow dries up the water arising at the contact with the warmer base, leaving only a thin film between the snow and the base.

L. C. W. Bonacina points out that though the winter of 1939-40 was relatively less remarkable for snow than for frost in the British Isles, there were a number of heavy snowfalls, that of the night of January 27 being very intense in the region lying outside the area of the severe ice-storm and quite unusual in Lancashire.

RESEARCH ITEMS

Acadian French in Louisiana

Results of anthropometric measurements of one hundred young men of almost complete Acadian French ancestry, students of the Southwestern Louisiana Institute, were communicated by H. N. Gould of Tulane University to the Columbus, Ohio, meeting of the American Association for the Advancement of Science, December 27–29, 1939. The subjects were descendants of French settlers deported from Nova Scotia in 1755–60, and belong to a community which has maintained a high degree of cohesion and isolation. Their body measurements do not differ by more than three or four times their probable errors from the corresponding measurements of Old Americans measured by Hrdlička. Such differences as there are point to slightly smaller dimensions in the Louisianians in body, head and face. They are taller on the average than the American soldiers of French descent in the United States army (Davenport and Love). They are superior in height to males in France. In hair colour there are few true blondes, and almost 80 per cent have hair in the range dark brown and brown-black. Red hair is absent. The percentage of light eyes, in spite of the dark hair, is as great as in the Old Americans generally, and the percentage of pure brown eyes is greater. Mixed eyes of irregular blue and brown pattern are relatively less frequent. In so far as this sample is reliable, the Acadian Frenchman of Louisiana is physically "Americanized".

Melanophores of the Cat Fish

G. H. Parker, in a paper read before the Columbus meeting of the American Association, directs attention to the controversy on what constitutes the resting state of the melanophores of the cat fish. It has been customary to compare the colour cells and their nerve fibres with muscles and their motor nerves. Some have regarded the contracted melanophore as being in the active state, and have taken the expanded cell for resting. Others have assumed the reverse to be true, and still others have claimed that both expansion and contraction represent active states. Experiment has shown, however, that none of these hypotheses is correct. A blind cat fish in the dark has no inducement to alter its colour, and fishes from which the eyes had been removed at various stages of darkening remained indefinitely in the condition in which they were at the time when the operation was performed. He concludes, therefore, that all degrees of expansion and contraction are states of rest, and that a state of action is only in evidence when the melanophore is changing from one state to another. The comparison with *skeletal* muscle is, therefore, most inappropriate, and, if such a comparison must be made, it should be between the colour cell and the *smooth* muscle fibre.

Position of Thylacine or Tasmanian 'Wolf'

Fifty or sixty years ago the marsupial wolf (*Thylacinus cynocephalus*) was a common Tasmanian animal, feeding upon small marsupials and sheep. As a consequence of the destruction of the flocks of settlers, the Government of Tasmania paid up to £1 a head for its slaughter, with the result that it was exterminated in the neighbourhood of settlements and found safety only in the wild western parts of the island. The threat of extermination resulted in prohibition of the export of the animal and its complete protection in the island. Unfortunately a new roadway linking Hobart with Queenstown has penetrated the wild country where the Thylacine appears to be making its last stand, and this adds a new threat to its survival. In order to estimate the present-day position of this rare creature, surveys of its territory have been made, and in one part it is reported from observation of tracks that "it was not unreasonable to estimate that the district contained as many as half a dozen pairs". M. R. S. Sharland considers that the creation of a sanctuary adjacent to the West Coast Road, including some 300,000 acres of land of varied character unsuitable for agricultural development, would best meet the needs of the Thylacine and other mammals (*Proc. Roy. Zoo. Soc. N.S.W.*, 20 ; 1938–9).

Black and the Striped Marlin

A detailed account of measurements and external features of these gigantic fishes is given by William K. Gregory and G. Miles Conrad (*Bull. Amer. Mus. Nat. Hist.*, 76 ; 1939). Microscopic examination of the gonads proves that there is little or no difference in external body form between the sexes of the black marlin, both male and female having been secured. A summary of the characters of the body-forms of the striped marlin, *M. mitsukurii*, the Atlantic blue marlin, *M. nigricans ampla*, and the Pacific black marlin, *M. nigricans marlina*, shows that although there is intergradation in all features of the body-form, there are proportional tendencies which when considered in groups serve to aid in separating them. They are generally easily distinguished by colour and other qualitative differences upon gross examination. The black marlin differs from the striped and the blue marlin in the fact that the pectoral fin, when adducted, remains in the horizontal position, whilst in the others it can be brought up flat against the side of the body.

Effect of Rubbing on Leaf Respiration

L. J. Audus has now extended his earlier observations upon cherry laurel leaves to cover a fairly wide series of leaf types, and in almost all cases has found a well-marked increase in the rate of evolution of carbon dioxide as the result of gentle rubbing of the leaf tissues (*New Phyt.*, 38, 284 ; 1939). In the case of softer mesomorphic leaves, they were held between the thumb and forefinger and then gently bent in different directions. Treatments which produced no visible damage were sufficient to produce a very marked increase in respiration. These results obviously have very considerable significance in connexion with many experimental investigations in which isolated leaves have been used and, necessarily in many cases, handled freely during the setting up of the experiment. They recall the earlier observations of J. M. Janse upon the marked effects produced upon the further growth of the roots of seedlings by a very slight amount of handling (*Proc. Koninkl. Akad. van Wetensch te Amsterdam*, 29, 834 ; 1926).

Maize Breeding

J. PHILP (*Bull.* 202, Min. Agric., Egypt) has shown that the F_1 of the inbred lines of maize derived originally from America and from native sources shows increased yields up to 27 per cent above the parental lines. The practical problems pertaining to Egypt's conditions are discussed, and it would seem that a great improvement in the crop yield is possible by this method.

Raspberry Mosaic

R. V. HARRIS (*J. Pom. and Hort. Sci.*, 17, 318; 1940) describes experiments in which mosaic disease was transmitted from nine varieties of European red raspberry and one American variety (Bath's Perfection) to the European variety Baumforth's *B*. All attempts to transmit the disease by mechanical means, such as injection with juice from infected canes, failed, but successful transmission was achieved by several different kinds of grafting. The symptoms induced in the test variety were in all cases recognizable as one of two distinct types, or as a combination of the two. They are ascribed to two different virus groups referred to as mosaic 1 and mosaic 2. Mosaic 1 always produced mild leaf symptoms of the same type, from whatever variety the infection was derived. It produced similar symptoms on two other varieties, Lloyd George and Reader's Perfection. These features are characteristic of a simple disease due to a single virus with a comparatively limited varietal distribution. Mosaic 2 comprises two or more diseases inducing leaf symptoms which are identical, but varying in severity from mild to very severe. Different varieties varied widely in susceptibility to mosaic 2, and masking of symptoms occurred on some varieties. In one case, Lloyd George, leaf symptoms were entirely absent from artificially infected canes, whilst with Preussen and Red Cross, symptoms were suppressed for a season, or limited to single leaves or canes. It is noted that great similarity occurs between mosaic 1 and mosaic 2, and the American diseases yellow mosaic and green mottle mosaic respectively.

Rocks of Mount Everest

IN the Records of the Geological Survey of India, 1939, pp. 171–188, L. R. Wager gives an interesting account of the Lachi Series of North Sikkim and the age of the rocks forming Mt. Everest. From Everest to North Sikkim a thick comformable series of sediments lying below the Jurassic and Cretaceous rocks of the Tibetan plateau, and often much metamorphosed and injected by granite, has now been distinguished and in part mapped. First there is the Tso Lhamo series, with fossils indicating a Triassic age. Below them is the Lachi series, an upper horizon of which contains an Upper Permian brachiopod fauna. Below this again is the Mount Everest limestone series of Carboniferous or Permo-Carboniferous age. These calcareous sediments form the actual summits of Mt. Everest and of several surrounding peaks. Towards the base of the series the limestone becomes more pelitic and is much metamorphosed by thick sheets of granite and granite-gneiss. The underlying rocks, though much injected by granite with formation of banded gneiss, are shown to consist of about 4,000 feet of dominantly pelitic sediments called the Mount Everest pelitic series. No fossils have yet been found in these rocks, but since the lie conformably below the Mount Everest limeston series they are probably of Upper Palæozoic age. I is clear that in the eastern Himalaya sedimentatio in the Tethys geosyncline began early—probably i or before Carboniferous times—and continued wit no serious interruption until the Eocene.

Mechanism of Wurtz Syntheses

THE study of some condensation reactions b sodium (A. V. Morton, J. T. Massengale and G. M Richardson, *J. Amer. Chem. Soc.*, 62, 120, 123, 126 129; 1940) leads to the view that the Wurtz product the dimer, is reached by way of an intermediat organometallic compound, for example, benzyliden disodium and benzyl sodium, there being no need t postulate any other special mechanism, although i is possible to superimpose on this view an ioni mechanism (organosodium compounds are salts) or free radical mechanism, and side reactions and de compositions may occur. Assumption of an inter mediate free radical provides at present a convenien explanation for some of the products. In the experi ments it is shown, for example, that no decane i formed prior to the formation of amylsodium in th reaction between amyl chloride with sodium, th amylsodium then reacting with addition of amy chloride. Ortho-phenyldiphenyl and diphenyl ar not metallated by phenylsodium but are by amyl sodium. Several other reactions are described in th papers.

Criteria of Moving Star Clusters

W. M. SMART has published a paper entitled "The Scorpio-Centaurus Cluster (The Southern Stream)" which disproves a view held for about a quarter of a century on a number of *B*-type stars, lying betwee galactic longitudes 210° and 330°, forming a movin cluster (*Mon. Not. Roy. Astro. Soc.*, 100, 2; Decembe 1939). If the Southern Stream is a real movin cluster, it should be possible to apply other criteri than those previously used to substantiate th hypothesis. Smart's procedure is similar to tha adopted in an earlier paper (*Mon. Not.*, 441; 1939) One very important result of the method is th determination, for each star of the so-called stream, of its own appropriate value of *K*, assuming that the existence of the stream is established. Rasmuson's list of 160 stars is used as the basis of the calculation in deriving the position of the convergent point; the equatorial co-ordinates of this (91°–37°) are close to the solar antapex. The stream velocity is derived by means of the observed total proper motions and spectroscopic parallaxes on the assumption that the stars form a moving cluster, and is found to be 18·8 km./sec. The application of the absolute magnitude criterion shows that the results are not hostile to the assumption of the stars in Rasmuson's list belonging to a moving stream, but are on the whole inconclusive regarding the constitution of the cluster. With the above stream velocity, the calculated radial velocity of each star is compared with the observed radial velocity, and if the stars move in a cluster the difference should theoretically be the *K* term. The result of the investigation is conclusive against the view that the stars under discussion form a moving cluster. In fact, the 'stream-velocity' is simply the solar velocity, and the 'convergent point' is the position of the solar apex.

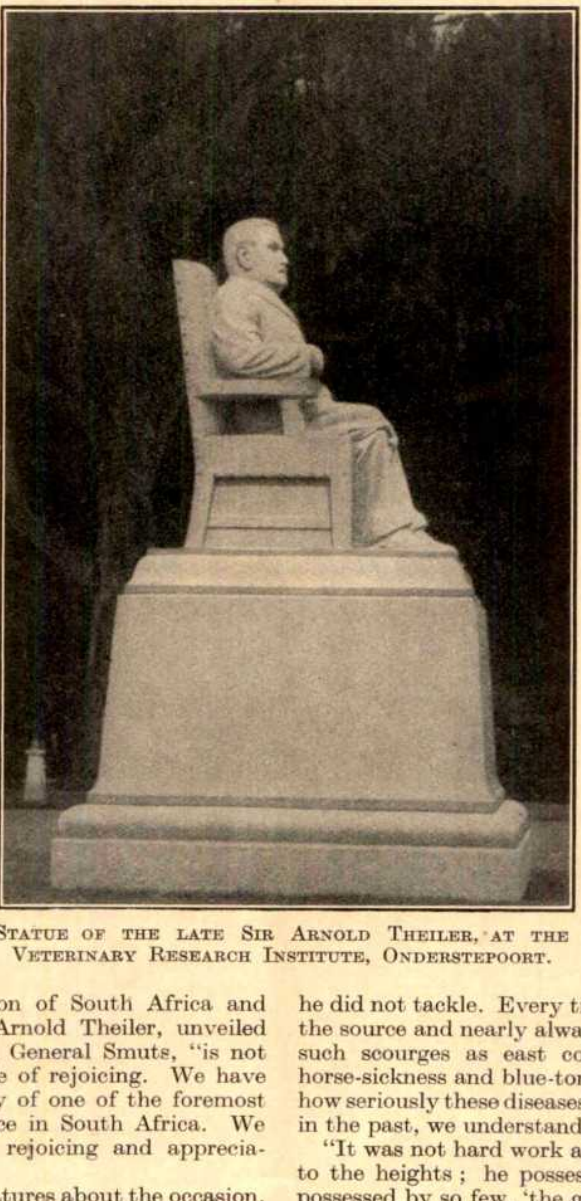
MEMORIAL TO SIR ARNOLD THEILER

SIR ARNOLD THEILER, founder and first director of the Veterinary Research Institute at Onderstepoort, near Pretoria, South Africa, died in London on July 25, 1936. His great services to veterinary science were widely recognized during his lifetime and many rewards and honours were showered on him. He received no less than seven honorary doctorates. Of other great distinctions may be mentioned his election to the Paris Academy of Sciences, the award of the Laveran Gold Medal, the Budapest Gold Medal, and the Gold Medal of the Royal Agricultural Society of England. He was an honorary or corresponding member of some twenty scientific societies.

After his death the country of his adoption bestowed an even greater honour on him than any he had received during his life. The Government of South Africa decided to erect a monument to his honour at the institute which he had founded

On Wednesday, November 15, 1939, before a large and distinguished gathering, including the members of the Diplomatic Corps, Cabinet Ministers, heads of Government Departments, many scientific workers and other prominent citizens, General the Right Hon. J. C. Smuts, Prime Minister of the Union of South Africa and a personal friend of Sir Arnold Theiler, unveiled the statue. "To-day," said General Smuts, "is not a day of mourning, it is one of rejoicing. We have come to honour the memory of one of the foremost men in the history of science in South Africa. We are filled with a spirit of rejoicing and appreciation.

"There are some special features about the occasion. Firstly, this is the only occasion on which a monument has been erected to a great man in the Union by the South African Government. Hitherto we have always left it to friends and admirers to collect funds for a memorial, but Sir Arnold seemed to this Government and the previous Government to be an outstanding case where an exception should be made. He had done such great service that we felt we were justified in erecting a memorial on behalf of the entire nation instead of merely of a group."



STATUE OF THE LATE SIR ARNOLD THEILER, AT THE VETERINARY RESEARCH INSTITUTE, ONDERSTEPOORT.

Secondly, said General Smuts, South Africans had been prone to honour men who had held high public posts in their country—statesmen, soldiers and outstanding public men. Sir Arnold, however, had not been in the public eye, he had not occupied a high position. He had been a man of science pure and simple, and had belonged to a branch of science which had no high honour attached to it—veterinary science. "But," continued General Smuts, "this veterinary doctor made himself, this institute, this country famous all over the world. More than any other man he has put South Africa on the science map of the world."

General Smuts touched on the history of Theiler. He mentioned how General Botha had encouraged the young Swiss veterinarian and how, realizing the vast importance of scientific work, he had sponsored the grant for the erection of the institute at Onderstepoort.

"There are many young men to-day who must have a vivid recollection of Sir Arnold Theiler's great personality. He was sincere, straight, powerful, enthusiastic, devoted to his work. Many books have been written on his scientific discoveries. There is not an animal disease of any importance which he did not tackle. Every time he found out the cause, the source and nearly always the cure. He worked on such scourges as east coast fever, red-water fever, horse-sickness and blue-tongue. And when we realize how seriously these diseases have retarded our progress in the past, we understand what a benefactor he was.

"It was not hard work alone which took Sir Arnold to the heights; he possessed that added something possessed by so few, 'the genius of insight'. And yet, in spite of his greatness, he was a simple soul; he lived and worked for his profession.

"We should be proud of this institute of Onderstepoort which he built up," said the Prime Minister. "The men here merely do their jobs. They are not politicians and I hope they never will be. They are here to carry on the scientific tradition of devotion to duty which he began."

The statue, made in granite quarried near Pretoria, was sculptured by Mr. Coert Steynberg.

RECENT RESEARCHES IN AMERICAN ARCHÆOLOGY

AMONG numerous evidences of increased interest in the United States of America in the antiquities of the continent and the origin, character and cultures of its earlier inhabitants is the fact that research in branches of study bearing upon such problems is no longer confined mainly to the more influential and populous intellectual centres, with their widely known and strongly supported universities, museums and other learned bodies. Local research, and even investigations implicating extended ramifications, are now appearing with regularity in the departmental studies of universities and academic institutions in the outlying and remoter States. Financial support, however, at least so far as concerns investigation in the field, is not always readily to be obtained, and various economies have to be practised. If these affect publication, as indeed frequently happens, results of importance may be overlooked, especially in Great Britain, where, unfortunately, it is sometimes difficult for archæologists to keep fully abreast with the progress of such research in America. Owing, however, to the financial limitations to which reference has been made, an index to activity in research, naturally not in archæology only, which alone is under consideration here, is afforded by the reports of bodies administering the various funds, to which scientific research in America is in the fortunate position of being able to look for support. Among such bodies, the American Philosophical Society takes a prominent place, owing to the value of the funds under its control, while the accounts of the researches it subsidizes which appear in the Year Book*, brief as they are, are a valuable guide to the trend of scientific investigation in widely extended fields throughout the academic world of the United States.

From this point of view, the following notes on recent archæological investigations, extracted from reports in the Year Book, will be of interest.

The discovery of characteristic stone artefacts attesting the existence of an early and primitive hunting people, who from the association of their relics, it is evident, were contemporary with a fauna pleistocene in character and now extinct—a people to whom the distinguishing name of Folsom man is assigned—has naturally given rise to inquiry as to how and by which route this culture and other cultures, apparently even earlier in time, reached the south-western States, the region of their discovery. The hypothesis that their penetration of the south-west was from the north, and took place in the Pleistocene age, by way of an ice-free corridor, has naturally stimulated investigation with the view of finding traces of the distinctive culture of Folsom man in the more northerly regions of the continent. The search has not been without result, notably in the work of Dr. F. H. H. Roberts in Canada. An investigation on similar lines was undertaken by Wesley L. Bliss, of the University of New Mexico, by whom an archæological and geological reconnaissance has been carried out in Alberta, the Mackenzie Valley, and on the Upper Yukon, with the financial assistance of the American Philosophical Society.

In the preliminary report the purpose of the investigation is stated to be "to tie in, if possible, early cultural and culture complexes in relation to glacial chronology". It followed on investigations already carried out in 1937 with the co-operation of the University of Alberta in which Yuma points, belonging to a south-western culture related to the Folsom culture, were located in eastern Alberta, and cultural affinities and contacts were demonstrated with British Columbia and Wyoming or the west coast, while abalone shell-pendants indicated connexions with the Californian coast. In the following season, geological investigations showed that all the area covered by the expedition along the Sikanni, Nelson and Liard Rivers of the Mackenzie River basin had been glaciated by Keewatin ice. Evidence of cave occupation by man was found near Blue Fish Lake, north of the Nahanni Butte, where ash layers overlay the blue clay deposited during glaciation, while information was obtained of smoke-darkened walls in two others. Search for evidence of man below the clay, which would prove human priority to the Keewatin advance of the ice in this region, is obviously desirable. The existence of an ice-free corridor from Bering Straits eastward to the Mackenzie delta was inferred from the absence of any evidence of glaciation in the valley of the Little Bell River, a tributary of the Yukon. Near Neon Lake, at the top of the pass, two terraces above the lake yielded artefacts comparable to the Pleistocene Lake Mohave artefacts of California and closely resembling those from the lowest cultural stratum of Borax Lake, California, which antedate the Folsom culture.

On returning to Alberta, field work was resumed, and four Yuma sites were found near Cereal, and two Folsom sites examined in western Saskatchewan. Of these, one near Mortlach is situated on the Altamont moraine and definitely dates Folsom as post-Wisconsin. An isolated flaked microlithic point from eastern Alberta is identical with points from the campus of the University of Alberta and also with those of the dune dwellers of Gobi in Central Asia.

Geographical conditions show that the great river basins of the north-west were more probable routes of migration from Asia than the rugged Alaskan and British Columbian coasts. Mapping of the Illinoian and Wisconsin moraines indicates an open corridor between the mountains and the continental glaciers in these periods.

Prior to this reconnaissance, nothing was known archæologically of the regions covered.

Recent archæological surveys of the south-western United States have been directed to the classification of the cultures found on occupation sites. Of the four basic cultures recognized, little is known by excavation of the Patayan culture, which centres in the Colorado River valley below Boulder Dam. In fact, north-western Arizona, to which this culture belongs, has been a blank place on the archæological map.

In the summer of 1938, an expedition of the Museum of Northern Arizona under Lyndon L. Hargrave, field director of the Museum, with the assistance of a generous grant from the Penrose

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* The American Philosophical Society. Year Book, 1938. Pp. 407. Philadelphia: American Philosophical Society, 1939.)

Fund, made an intensive study of sub-cultures of the Patayan culture, excavating a site seven miles north of Williams, Arizona, which consisted of a large masonry fort and seventeen earth lodge sites. A preliminary conclusion, pending further analyses, establishes the existence of the Cohonina Branch of the Patayan culture, differing essentially from the Hohokam of the south and the Pueblo to the east. A relationship to the people of the Colorado to the west is suggested.

The Cohonina lived a semi-sedentary life, part agricultural, part food-gathering. Their homes were surface structures built of perishable material, earth lodges, of which the detailed architecture is difficult to trace. Much charcoal was collected, which, however, has as yet yielded no dendrochronological evidence. Ceramic types date occupation at about A.D. 700 and A.D. 1100, the fort with its massive masonry belonging to the later period of occupation. A special projectile point was used to which the name "Cohonina point" has been given. Few ornaments were used, none of shell. The pottery belongs to the San Francisco mountain gray ware; and from its distribution it is possible to fix the extension of the Cohonina Branch—the area between the Little Colorado River on the east and the escarpment of the plateau on the west, and from the Grand Canyon on the north to the San Francisco volcanic field in the south.

An investigation of primitive Indian agriculture in the south-west by Edward F. Castetter, of the University of New Mexico, throws light on the crops grown anciently in this region. A preliminary survey was made of the technique, crops and implements among Mohave, Yuma, Cocopa, Maricopa, Papago, Pima, and a number of Pueblo groups. The ancient crops were maize, beans, pumpkins, cotton, tobacco and gourd. In addition, the Colorado River tribes sowed several species of grasses. The Pueblo peoples had a much greater variety of corn and beans than the peoples of the Gila and Colorado Rivers, who had only four—yellow, blue, white and speckled, all corn of the flour type. The pumpkins were *Cucurbita moschata*. It was found that agriculture could not be investigated adequately without knowledge of ritual, the two being inseparable; but it was difficult to obtain information owing to the secrecy of the Indians, especially the Pueblo, on such matters.

BIOLOGY AND SYSTEMATICS OF THE SARGASSUM WEED

MATERIAL for research on the floating Sargassum vegetation of the western North Atlantic was collected in connexion with a series of hydrographic cruises to the central American seas on the research ship *Atlantis*, sponsored jointly by the Woods Hole Oceanographic Institution and by Yale University (under the auspices of the Bingham Oceanographic Foundation), a special surface net being used which was designed to gather floating weeds from the sea surface on a quantitative basis, and the results of the researches have now been published*.

This net has been in actual operation on the surface of the Sargasso Sea and of the central American seas for a total cumulative towing length of nearly 7,000 nautical miles, and as a result of this towing more than 4,700 pounds of pelagic weeds have been sorted and weighed on board. Experimental evidence shows that these weeds do not occur in any quantity at any significant distance below the surface.

In the taxonomic discussion a key is given for the identification of the main types of floating Sargassum weed, illustrated by a number of silhouettes. The author concludes that the fixed, more or less distinct, external forms in which the truly pelagic weeds occur represent only phenotypic variations of not more than two separate species, *S. natans* and *S. fluitans*. Even the distinctness of these two species, although probable, is not established entirely without doubt.

The quantitative estimates show that floating weed is scarce in the Caribbean and Cayman Seas and practically absent from the entire southern half of the Caribbean itself, whilst in the north-western region of the Gulf of Mexico a secondary accumulation of apparently deteriorating weeds in considerable abundance was observed over a wide area. The chief region for thriving pelagic weeds was entirely outside the central American seas in that part of the North Atlantic designated as the Sargasso Sea.

The distribution, as shown in these results, confirms the previous hydrographic conclusions, that the failure of the drifting flora to penetrate northward across the Caribbean agrees with the assumption that the Caribbean surface water is mainly derived from the south-east via the north equatorial current and not from the Sargasso Sea itself. The accumulation of floating weed in the north-western part of the Gulf of Mexico must be interpreted as a result of pure wind drift, due to prevailing easterly winds moving the weeds in relation to the water; this accumulation could scarcely take place in the presence of a significant tendency to outward movement of the surface water towards the Straits of Florida.

Up to the present time, no benthonic fixed stage is known of the two species *S. natans* and *S. fluitans*, and it has been a controversial subject as to whether these weeds grow vegetatively to any great extent in the floating state. Recent authorities increasingly favour the theory that such growth does take place, and the present work shows conclusively that these weeds grow and prosper for years without any sexual reproduction; and further, there can be no conceivable source and process of annual renewal of pelagic Sargassum vegetation from benthonic flora which could possibly maintain the floating vegetation in its observed abundance with an average duration of the pelagic state of the individual plants to be reckoned in less than decades. One fertile plant attached to a drifting piece of wood was obtained which was otherwise indistinguishable from sterile representatives of the pelagic *S. fluitans*, the only one ever found and of great importance in showing the form of the sexual phase, as it will now be possible to search for a known fixed form.

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* "Quantitative Observations on the Pelagic Sargassum Vegetation of the Western North Atlantic. With Preliminary Discussion of Morphology and Relationships". By Albert Eide Parr. *Bull. Bingham Oceanographic Collection*, Peabody Museum of Natural History, Yale University, 6, Art. 7. Dec. 1939.

It is thus firmly maintained, supporting Winge (1923) and others, that "the pelagic *Sargassum* of the Sargasso Sea, apart from its marginal zones, is probably an essentially self-sustaining unit with a potentially infinite longevity and a very long normal expectancy of life for its individual plants, receiving (at most) only a very slight annual contribution from benthonic vegetation merely sufficient to compensate for its own loss by a slight excess of mortality over vegetative growth increment, suffered mainly through a continually occurring chance return of some of its members to the dangerous marginal zones from which a corresponding recruitment of freshly detached plants which have escaped its hazards are received in exchange."

The significant fact remains that no fixed benthonic stage is yet known of either of the two predominant types of floating Sargassum weed of the Sargasso Sea, namely, *S. natans* and *S. fluitans*. It seems that it must be concluded that here we have an essentially self-sustaining community of plants in which the pelagic existence has become secondarily normal, and which are able to maintain and multiply themselves indefinitely by mere vegetative growth, mechanical fragmentation and irregular partition of the individuals through disintegration from the basal end.

RECENT AMERICAN INVESTIGATIONS IN EMBRYOLOGY

AN interesting paper of practical importance in orthopædic practice, entitled "The Functional Results of Muscle Transposition in the Hind Limb of the Rat", was read by Prof. R. W. Sperry at the Columbus Meeting of the American Association last December. The muscles operating the hind foot of this animal were transplanted in reverse, with the result that both reflex and voluntary movements of the hind limb were also reversed. Motion pictures showed that even after a year's trial of the new arrangement, there was no adjustment, and although the muscles worked the limb, the motor nerve patterns for limb co-ordination were on the old basis. Unfortunately the author does not state the names or number of the transplants.

Papers on experimental embryology related to the early development of the sea urchin, *Arbacia punctulata*. Profs. W. C. Allee and Asher J. Finkel, starting from the observed acceleration in cleavage-rate due to density of egg population and suspecting that some growth-promoting substance was responsible, carried out a series of experiments at Woods Hole with the intention of finding out more about the stimulating factor. They did not succeed in determining the chemical nature of the substance or substances; but their experiments showed that an extract from *Arbacia* eggs, even in "extremely dilute concentrations, can accelerate the early development of *Arbacia* eggs to a significant degree over that of untreated but otherwise similar eggs". They suggest that "undercrowding is as real in its effects as overcrowding".

Miss Ethel Browne Harvey studied the role of the nucleus and the cytoplasm in *Arbacia* eggs. Unfertilized eggs, broken into half eggs by centrifugal force, give a nucleated and a non-nucleated half. Both halves can be fertilized, or activated artificially. In the former case two plutei are produced; in the latter, the nucleated half becomes a pluteus, the non-nucleated half a blastula only. Fertilized eggs behave differently. A half containing both pronuclei forms a blastula, or at most a defective pluteus. A non-nucleated half, although its cytoplasm is affected by fertilization, does not even cleave, but the cytoplasm may make an attempt to produce asters.

The author calls the development of the non-nucleated half of the artificially activated but unfertilized egg "parthenogenetic merogony". But since this half develops to the blastula stage only, it would appear that a nucleus is essential for the *differentiation* of the cells, though not for their mere multiplication.

Prof. Robert Chambers and E. L. Chambers found that fertilization of the egg in *Arbacia* could be arrested by immersing the egg immediately after insemination in a solution of potassium chloride, the strength of which is not stated. The return of the eggs so treated to normal sea-water more than an hour later causes resumption of activity of the sperm and subsequent normal development.

Two papers on transplantation of embryonic limb buds in birds were read by Prof. H. L. Eastlick. In the first set of experiments the chick embryo was the host, and duck, chukar partridge, quail, guinea fowl and turkey were the donors of the grafts. Both leg and wing were employed, transplantation being effected on embryos two to three days old. The egg was then re-sealed and put back in the incubator for further development. Fifteen per cent of the embryos hatched with the graft as a fifth limb. These grafts retained the structural characters of the donor species, except in a few cases where a partial merging of skin characters of donor and host occurred. Thus a duck leg graft formed a webbed foot, the feathers of which failed to develop after a poor attempt to do so; they were followed by a second growth of host feathers. In other cases the graft limb grew at first but was later resorbed.

According to a second paper the birds mentioned above were used as hosts, but did not prove as successful for this purpose as the chick. Although the graft retained many of the characters of the parent bird, the age and extent of the graft affected the result. In particular, a graft removed with a portion of the neural crest developed feathers of the same colour as the graft's parent, whereas a graft cut laterally so as not to include the neural crest partook of the colour characters of the host. Grafts from white silky bantams, the feathers of which have no hooklets on the barbules, retained this character when transplanted to White Leghorn or Barred Plymouth Rock hosts. Prof. Eastlick described and illustrated some of his results in a brief communication published in NATURE of August 26, 1939, p. 380.

ROAD RESEARCH

THE work of the Road Research Laboratory during the year ended March 31, 1939, is described in the annual report now obtainable*.

An important event recorded is the enlargement of the site of the Laboratory by sixteen acres, which has made possible the construction of a special skidding track 2,000 ft. long, providing facilities for investigating the causes of skidding under more favourable conditions than exist on the roads and forming a useful calibration surface for the several machines used by the Laboratory and by the Ministry of Transport. A notable feature of the report is its indication of the way in which the research work is now evolving from the purely laboratory stage into the large-scale practical demonstrations of the road engineer. Examples of this development which are to be found in the report include the full-scale tests on the use of acid to reduce the slipperiness of smooth concrete surfaces, the treatment by chemicals of ice-bound concrete surfaces and durability tests on bituminous and asphaltic binders. In co-operation with the Timber Development Association extensive practical trials are proceeding with the view of improving the skidding resistance of wood-block surfaces, while other large-scale investigations have led to a better design of cast-iron surfacing by which the sideway force coefficient has been increased from about 0·25 to 0·45.

Soil mechanics in several important aspects continues to be developed, and experience of soil surveys undertaken in conjunction with the Ministry of Transport prior to the building of experimental roads has confirmed the view that useful and often essential information can be obtained in this way. As knowledge of subsoil conditions accumulates, it is reasonable to expect that the value of such soil surveys, preliminary to construction, will become progressively greater. The principal addition to the equipment of the Soil Mechanics Laboratory during the year has been an apparatus for obtaining undisturbed samples of soil, which operates a sampling tool by means of a double-acting hydraulic ram. After a hole has been drilled in the ground to the required depth, the tool is lowered into position and pressed home by the 10-ton ram. Incorporated in the tool-head is a relief valve which permits air or water to be expelled. The samples are tested in a new type of consolidation machine which also has been designed and constructed at the Road Research Laboratory during the year. An illustration shows a machine of a simple lever-loading type in which the specimen is held rigidly against a steel ball, the deformation being indicated on a dial gauge. In this department of the work, standard tests are being developed and the mechanical and physical properties of soils are being investigated, particularly in relation to the shrinkage of stabilized soils and the principles of soil compaction.

As already indicated, road surfacings receive a large share of attention. The report gives further details of the system of recording progressive changes in roads by means of the recently developed surface texture prints. These, as described in NATURE of January 6, p. 40, are a form of offset prints made on sheets of paper by means of a printing roller run over a small area of the road surface.

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* Report of the Road Research Laboratory. (H.M. Stationery Office. 3s. 6d. net.)

SEVENTY YEARS AGO

NATURE, vol. 1, April 7, 1870

Natural Science at Cambridge

WE have heard so much recently of the long-delayed determination of Cambridge University to apply itself in earnest to the cultivation of Natural Science, that the information in the following paragraph must be a blow to those of its friends who hoped to see that it was entering on a new course: "The Syndicate appointed to consider the means of raising the necessary funds for establishing a Professor and a Demonstrator of Experimental Physics, and for providing buildings and apparatus . . . have made a report to the Senate, in which they state that they have addressed a communication to the several colleges of the University, to inquire whether they would be willing . . . to make contributions from their corporate funds for the above-mentioned objects. The answers of the several colleges, except that of King's, which has not yet been received . . . indicated such a want of concurrence in any proposal to raise contributions from the corporate funds of colleges, by any kind of direct taxation, that the Syndicate felt obliged to abandon the motion. . . . They confined their attention, therefore, to the means of raising sufficient funds only for carrying out the recommendations of the Physical Science Syndicate in their report dated Feb. 27, 1869. These were to provide the stipends of a Professor of Experimental Physics, of a Demonstrator and an attendant, requiring altogether a sum of 660 *l.* per annum; also to provide a capital sum of 5000 *l.* for a new building, and 1300 *l.* for apparatus. The Syndicate are of opinion that these sums may be raised from the ordinary sources of revenue of the University."

The Rotundity of the Earth

A RECENT number of the *Field* contains an account of a very amusing investigation which has been recently conducted on the Bedford Level to settle the question whether the earth is a globe or not! It appears that a Mr. Hampden threw out a challenge by which he offered to pay 500 *l.* to anyone who would prove the rotundity, which challenge has been taken up by Mr. A. R. Wallace, who has lodged a similar sum with the Editor of the *Field*. To test this point, six miles of the Bedford Level were used, three signals, each 13 feet 4 inches above the water level, being put up three miles apart. Mr. Wallace asserted that if he were correct the central signal would appear elevated about 5 feet above the line joining the other two; Mr. Hampden holding, of course, that they would all be in the same straight line.

Although the diagrams of what was seen by the telescopes used at both ends, and acknowledged to be correct by Mr. Hampden and his associate, show the central signal more than 5 feet above the line of the two extremes, "these gentlemen coolly claim the victory, and threaten to bring an action against the Editor of the *Field* (who was appointed unpire by Mr. Hampden himself) for fraudently deciding against them."

WE hear from Edinburgh that there is much excitement amongst the supporters of the Lady Medical Students, on account of the Professor of Chemistry refusing to accord one of the Hope Scholarships to Miss Edith Pechley, who, by the number of marks gained, is entitled to a junior scholarship.

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, April 9

Chadwick Lecture (at the Royal Society of Tropical Medicine and Hygiene), at 2.30 p.m.—William H. Hamlyn: "Camps, their Design, Construction and Hygienic Arrangement" (Bossom Gift Lecture).*

Zoological Society of London, at 5 p.m.—David Lack: "Evolutionary Problems of the Galapagos Finches", together with a Film "Animal Life of the Galapagos". William Holmes: "The Colour Changes and Colour Patterns of *Sepia officinalis* L."

Royal Photographic Society, at 7 p.m.—W. W. Nicholas: "Bird Watching with Still and Cine Camera".

Pharmaceutical Society, at 7.30 p.m.—Dr. C. H. Hampshire: "Pharmacopoeia Revision".

Thursday, April 11

Linnean Society of London, at 5 p.m.—General Meeting.

At 5.25 p.m.—(Joint Meeting with the Association for the Study of Systematics in relation to General Biology): A Symposium on Phylogeny and Taxonomy. (Speakers: J. S. L. Gilmour, Dr. O. W. Richards, Dr. T. A. Sprague, Dr. E. I. White.)

Council for Education in World Citizenship (at Somerville College, Oxford), at 8.15 p.m.—Dr. Gilbert Murray: "World Citizenship, the Growth of an Idea" (Inaugural Address).*

Friday, April 12

Royal Aeronautical Society (at the Institution of Electrical Engineers), at 6.30 p.m.—Sir Alan Cobham and Marcus Langley: "Flight Refuelling".

Society of Chemical Industry (Joint Meeting of the Chemical Engineering Group and the Food Group), at 8 p.m.—T. W. Jones: "Chemical Engineering Problems in the Canning Industry", followed by a general discussion. (Speakers: Osman Jones and F. D. Farrow.)

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Temporary Pathologist—The Secretary, Hospital for Consumption, Brompton, S.W.3 (April 10).

Chemist and Bacteriologist—The Water Engineer, 70 Park Lane, Croydon (April 12).

Technical Assistant in the County Land Drainage Officer's Department—The Clerk to the Essex County Council, County Hall, Chelmsford (April 13).

County Librarian—The Education Officer, County Hall, Wakefield (April 15).

Woman to organize and give instruction in **Horticultural and Agricultural Subjects of Domestic Economy**—The Clerk of the Cambridgeshire County Council, Shire Hall, Cambridge (April 15).

Experimental Assistants (female) at the Ministry of Supply—The Secretary (S.E.3b), Ministry of Supply, Adelphi, W.C.2 (quoting Appts. 024/SE.3b) (April 16).

Workshop Instructor and Lecturer in Production Engineering at the Kenrick Technical College—The Director of Education, Education Offices, Highfields, West Bromwich (April 19).

Organizer for Schools Service (female)—The Director, Museum and Art Gallery, Leicester (April 20).

Assistant Livestock Expert for Animal Husbandry Work in Bengal—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 9/2A) (April 27).

Lecturer (Grade III) in the Department of Zoology—The Acting Secretary of University Court, University, Glasgow (April 30).

Lecturer (Grade IIb) in the Department of Applied Physics—The Acting Secretary of University Court, University, Glasgow (April 30).

Principal of the Ceylon University College—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

Assistant Mechanical Engineer for the Tanganyika Government Railway—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9193).

Executive Engineer for the Public Works Department, Government of Trinidad—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9197).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Non-Ferrous Metals Research Association. Research Reports, Association Series, No. 524: Quantitative Spectrographic Analysis with the Microphotometer. Part 1: A Review of Published Work. By D. M. Smith. Pp. 24. (London: British Non-Ferrous Metals Research Association.) 2*s*. [153

Report on the Phenological Observations in the British Isles from December 1938 to November 1939. By Major H. C. Gunton. (No. 49.) (*Quarterly Journal of the Royal Meteorological Society*, No. 284, Vol. 66.) Pp. 95–142. (London: Royal Meteorological Society.) 3*s*. [183

University of Birmingham. Report of the Vice-Chancellor and Principal to the Council, for the Thirty-ninth Session, 1938–39. Pp. 32. (Birmingham: University of Birmingham.) [193

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 2: The Maximal Range of Error in Gross Reproduction Rates. By Dr. Enid Charles. Pp. 18–32. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1*s*. 3*d*. [203

Other Countries

Tsetse Research Department, Tanganyika Territory. A Field Key to the Savanna Genera and Species of Trees, Shrubs and Climbing Plants of Tanganyika Territory. Part 1: Genera and some Species. By B. D. Burtt. Pp. xvi+53. (Dar es Salaam: Government Printer.) 2*s*. [123

Indian Population Problems. Report and Proceedings of the 2nd All-India Population and 1st Family Hygiene Conference. Edited for the Executive Committee by Prof. G. S. Ghurye. Pp. 336. (Bombay: Karnatak Publishing House.) 5 rupees. [123

Annual Report of the Imperial Council of Agricultural Research for 1938–39. Pp. viii+170. (Delhi: Manager of Publications.) 1.8 rupees; 2*s*. 3*d*. [123

Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1938, together with the Thirty-second Annual Report of the Centre Committee of the Association for the Year ending 31st March 1939. Pp. 79. (Coonoor: Pasteur Institute of Southern India.) [123

Year-Book of the Royal Asiatic Society of Bengal. Vol. 5, 1939. Pp. 163. (Calcutta: Royal Asiatic Society of Bengal.) 4.2 rupees. [123

Maryland Geological Survey. Map of Maryland showing Geological Formations. Scale 1 : 380,160 = 6 miles to 1 inch. 44in. × 26½in. 1 dollar. Map of Maryland showing Surface Elevations. Scale 1 : 380,160 = 6 miles to 1 inch. 44in. × 26½in. 75 cents. Map of Carroll County showing the Geological Formations. Scale 1 : 62,500 = 1 mile to 1 inch. 38in. × 36in. 50 cents. Geologic Map of Frederick County and adjacent parts of Washington and Carroll Counties. Scale 1 : 62,500 = 1 mile to 1 inch. 53in. × 40in. 50 cents. (Baltimore, Md.: Maryland Geological Survey.) [133

Sveriges Geologiska Undersökning. Ser. Aa, No. 178: Beskrivning till kartbladet Gävle. Av R. Sandegren, B. Asklund och A. H. Westergård. Pp. 144+1 plate. (Stockholm: P. A. Norstedt and Söner.) 4.00 kr. [143

Gold Coast Colony. Annual Report on the Forestry Department for the Year 1938–39. Pp. iii+21. (Accra: Government Printing Office; London: Crown Agents for the Colonies.) 2*s*. [143

Ingeniørvidenskabelige Skrifter. Nr. 4: The Acoustic Air-Jet Generator. By Jul. Hartmann, in co-operation with Peter v. Mathes, Elisabeth v. Mathes and Freimut Lazarus. (Akademie for de Tekniske Videnskaber og Dansk Ingeniørforening.) Pp. 266+14 plates. (København: G. E. C. Gad.) [143

Indian Forest Records (New Series.) Utilization, Vol. 1, No. 8: Notes on the Air Seasoning Characteristics of some Indian Woods (Supplement to the Manual on the Air Seasoning of Indian Timbers.) Dr. S. N. Kapur and M. A. Rehman. Pp. iii+211–232. (Delhi: Manager of Publications.) 8 annas; 9*d*. [153

Annual Return of Statistics relating to Forest Administration in British India for the Year 1937–38. Pp. 40. (Delhi: Manager of Publications.) 2.4 rupees; 3*s*. 9*d*. [153

Supplement to the American Ephemeris, 1940. Total Eclipse of the Sun, October 1, 1940. (Issued by the Nautical Almanac Office, U.S. Naval Observatory, under the authority of the Secretary of the Navy.) Pp. 57. (Washington, D.C.: Government Printing Office.) 1·50 dollars. [193

Fifty-sixth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1938–39. Pp. 10. (Washington, D.C.: Government Printing Office.) [193

U.S. Department of Agriculture. Technical Bulletin No. 692: Chemical and Mechanical Methods of Ribes Eradication in the White Pine Areas of the Western States. By H. R. Offord, G. R. Van Atta and A. E. Swanson. Pp. 50+11 plates. (Washington, D.C.: Government Printing Office.) 15 cents. [193

National Research Council. American Geophysical Union Transactions of 1939. Part 1: Reports and Papers, Regional Meetings (a) South Pacific Area, Los Angeles, California, December 16–17, 1938; (b) North Continental Divide Area, Spokane, Washington, December 28, 1938. Pp. 140. 1.25 dollars. Part 2: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Symposium on Floods, Section of Hydrology. Pp. 141–234. 1 dollar. Part 3: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Reports and Papers, General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 235–484. 1.75 dollars. Part 4: Twentieth Annual Meeting, April 26 to 29, 1939, Washington, D.C.; Reports and Papers, Section of Hydrology. Pp. 485–740. 1.75 dollars. (Washington, D.C.: National Academy of Sciences.) 5 parts, 5 dollars. [193

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CO-OPERATION IN COLONIAL ADVANCEMENT

UNQUESTIONABLY the most striking fact to emerge from Lord Hailey's "African Survey" is the vastness of the field for scientific research and the application of its results to the needs of the native populations which are afforded by that continent. On a careful examination of the evidence which has been brought together of Lord Hailey's work of impartial observation, it is patent that if these peoples are to benefit to the full from the increased interest in their lot now manifested by the European Powers responsible for their future, a more carefully considered and scientifically informed approach to the problems of the administration of their affairs and of their future development is demanded. Nor is this an affair merely of the moment or the immediate future. No measures for the promotion of native advancement, however well-intentioned, will prove beneficial in the long run—as experience has shown time and again—which has not been framed in the light of the fullest knowledge of the essential character of native culture and its reactions to impact from outside.

As Lord Hailey has shown in detail, there is a considerable difference in outlook, in purpose and in method as between the administrative services of the various European powers concerned with African peoples. While it is doubtful whether it would be practicable, or even advisable in view of the wide differences in temperament, culture and attainment of the various African peoples, to attempt to secure absolute uniformity in administrative methods, yet unquestionably some agreement as to the general direction of policy in native development is more than desirable. In fact, sooner or later it may become an essential condition of European participation in the promotion of African development.

In these circumstances, it is a reassurance for the future that Allied co-operation is to be as effective in the colonial field as in other spheres of the joint interests of France and Great Britain. As a result of Mr. Malcolm MacDonald's recent conference in Paris, the more or less tentative approaches of the French and British colonial administrations in recent years are to be reinforced by the creation of an organization which will secure a permanent liaison between London and Paris. In the French and British Colonies themselves, which in many parts of the world, but more especially in Africa, lie adjacent to one another, there will be conferences from time to time between the governors of the British and French territories, while contact will be established between the administrative and specialist officers of the respective services.

How far this co-operation between French and British colonial authorities will lead ultimately towards any close community in fundamental principles of administrative policy it is of course at present impossible to say. On a superficial view, in outward form French colonial administrative methods, by the employment of native local chiefs and headmen, bear a certain resemblance to the methods of British 'indirect rule'; but there is at present a fundamental difference in attitude towards native authority as an instrument of administration. This would militate against anything in the nature of a condominium such as exists in the New Hebrides, which has been put forward by some as a desirable or possible outcome of the present approach to joint and common action in the Colonies between France and Britain.

British native administrative policy, fortified by experience in many parts of Africa, is wedded to the principle of 'indirect rule'; but it has not been thereby immune from criticism. On one hand, opinion among the more advanced and highly educated natives, especially in West Africa, is prone to regard its respect for native institutions and the desire to preserve their influence unimpaired as an attempt on the part of administrator and anthropologist to retard native development; on the other hand, the impartial judgment of qualified European observers fears an indiscriminate application of the principle in circumstances in which its cardinal factor, the native institution, is no longer operative, as for example in urbanized or industrialized populations, which have become cosmopolitan, in an African sense, rather than tribal. In the train of thought to which this gives rise, it is probably wise to give full weight to arguments which tend to emphasize the fact that 'indirect rule' in effect is 'local government' and stress its educative value.

At the same time, it should not be overlooked that in the light of the modern methods of investigation of social anthropology, the application of indirect rule has at times failed in scientific appreciation of the facts of native institutional practice upon which *ex hypothesi* it should be founded.

There is a larger and more far-reaching consideration to which attention may be directed. While indirect rule has as its immediate aim the preservation of tribal authority and the conservation of the forces which make for tribal integration, it does this as a means to an end—or so at least it is held by enlightened opinion—the ultimate advancement of the native peoples of Africa to take such a place among the peoples of the world as their capacities, circumstances and opportunities admit. However far they may have to go, some conception of direction, and the agencies by which this end is to be attained, should form a part of that planning on a world-wide basis which must in the long run be a consequence of the present struggle.

It is open to question, however, whether the colonial authorities, both at home and in the field, are not prone to overlook this consideration, and in danger of regarding indirect rule as to be pursued as an end in itself. Even the staunchest upholders of the principle appear to be somewhat vague as to ultimate aims. That the interests of the native population should be paramount, excellent as it may be as a principle of government, depends in its application too much upon the interpretation of 'interests' to afford any precise guidance.

In the recently issued White Paper on colonial development, while generous financial assistance is promised for both development and research, stress is laid on the primary purpose of assisting the colonies towards becoming self-supporting. Now Africa, as a whole and on the whole, is poor country, and in any event the burden of development for long must fall upon white shoulders. In the course of that development, involving presumably a change-over from what is now a bare subsistence basis for the native population to something in the nature of an industrial or potentially commercialized form of production, concern for native 'interests' may be in danger of suffering a sensible diminution.

The issues involved in the relations of a white and a native African population have been set out, though in a widely different context from that in which indirect rule has been applied, with admirable lucidity and an absence of bias by Prof. R. F. A. Hoernlé in his Phelps-Stokes Lectures for 1939*. He discusses there the native problem as it now presents itself in the Union of South Africa. As in other of the older colonies of Great Britain in Africa, the relations of white and black in South Africa up to a point have reflected the growth of a sense of responsibility in the mother country, whether due to the humanitarianism which abolished slavery or the consciousness of the 'white man's burden,' by which, in the eyes of many, imperialistic expansion found its justification. It has its modern counterpart in the 'trusteeship' which is now the avowed principle of the mandatory and colonial administration. In South Africa, however, the 'liberal spirit' which once fostered native advancement has given way, under stress of racial feeling, which is closely bound up with questions of economic competition, to a reaction which approaches native policy primarily and to all intents and purposes solely from the point of view of the maintenance of the dominance of the white and superior race in the Union. When it is remembered that here the black population outnumbers the white in the ratio of between three and four to one, the difficulties which confront those who advocate a more liberal approach to the problem become easily understood.

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* South African Native Policy and the Liberal Spirit: being the Phelps-Stokes Lectures delivered before the University of Cape Town, May 1939. By R. F. Alfred Hoernlé. Pp. xiv+190. (Lovedale, C. P.: The Lovedale Press, 1939.) 5*s*.

It is a far cry from the complexity of social and racial conditions in South Africa to the relatively simpler societies to which indirect rule has been applied. Yet the germs of South Africa's problem are there; and they will grow unless measures be taken in time. It has been said that we are waging a war in which the aim of the Allies is to establish Christian civilization as against the paganism of nationalism and the worship of the State. But as Sir Francis Younghusband has pointed out, neither Islam nor Hinduism, nor Confucianism nor other creeds can be excluded from our aims, insomuch as we welcome their assistance. Our battle is for the principles which lie at the root of Christianity, it is true, but are no less the articles of faith of all men of good will irrespective of creed—the dignity and integrity of the individual man free to develop mind and body to the limits of his capacity within free institutions. For better or for worse, white civilization has impinged upon the black. It is incumbent upon us, if we are to be really true to the principles for which we stand in the present struggle, to see to it that our rule over the less advanced peoples is a tutelage which does not overlook their claims to co-operate in a world order in the coming era of, we hope, a more rational, as well as a more humanitarian, world.

ANGLO-FRENCH CO-OPERATION IN SCHOOLS

On September 3, Lord De La Warr, who was then president of the Board of Education, visited Paris to discuss with the French Minister of Education, M. Sarraut, the contribution which the schools of the two countries can make towards Anglo-French solidarity.

The event followed a discussion in London at the end of January last on intellectual co-operation between visiting French Ministers and their opposite numbers. Committees were afterwards set up by the Education Ministries of both countries, the aim of which is to develop existing means and to devise fresh ones for increasing among the school children of each country knowledge and appreciation of the life and culture of the other country. During the visit, which was marked by a broadcast in French by M. Sarraut and Lord De La Warr, members of the two committees met to discuss each other's work. After the visit to London to which we have already referred, a special commission of experts was set up in France to recommend ways of ensuring that French children obtain a thorough knowledge of Britain and the British, the affinities and differences of the two peoples, and their common aims in civilization. Any report which the commission has now prepared would doubtless be discussed during the Paris visit.

This move towards closer intellectual co-operation would have been desirable even had there been no war. In the present circumstances, it is inevitable and essential as a part of plans for Allied co-operation which grow more and more comprehensive. The Anglo-French declaration of war and peace policy carries with it the necessity of closer contacts between the youth and intellectual life of the two countries. Upon those who are young now will rest the responsibility of clinching victory and securing the maintenance of peace in the future. That responsibility must obviously entail closer understanding in the realm of ideas. It is in the schools, as Lord De La Warr pointed out in his broadcast, that the two peoples. so different in many ways, can learn of one another. It is in the schools that they may learn what they have both given, and are giving, to civilization and culture, what are the things for which, and against which, the present war is being waged. There was grim warning in Lord De La Warr's statement that, from the point of view of the future, the most terrible crime of the Nazi régime is the deliberate perversion of the minds and souls of their young people.

In France, where educational machinery is more centralized than in Britain, rapid innovations are possible. In English schools, nevertheless, special means have already been devised towards the ends in view. More than half a million are learning French, and the number can be increased by new effort. New programmes have been drawn up for school broadcasts and new plans for a wide circulation of films and for special lecturers to tour the schools. There are possibilities, too, of new books on French life, and of arranging exchange visits of teachers and children. These activities should make a substantial contribution to the preservation and development of the ideals for which Britain and France stand.

THE ULTRACENTRIFUGE

The Ultracentrifuge

By The Svedberg and Kai O. Pedersen, in co-operation with J. H. Bauer and E. P. Pickels; G. Boestad; E. O. Kraemer and J. B. Nichols; O. Lamm; A. S. McFarlane; R. Signer. (International Series of Monographs on Physics.) Pp. x+ 478+ 31 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 40*s*. net.

PROF. SVEDBERG'S institute at Uppsala has been for some years now a world-famous international club, with notices in several languages which may or may not include Swedish. The book just published summarizes the work of the staff and visitors with the ultracentrifuges during fifteen years of steady progress. It is significant of its international character that the authors consist of three Swedes, one Dane, four Americans, one Scotsman, and a Swiss. Of the two chief authors, Prof. Svedberg confines himself mainly to the constructional part, showing clearly how, "given the height and thickness of the column of solution and its distance from the centre of rotation, all other mechanical characteristics of the ultracentrifuge can be directly derived". The other main author, Dr. Pedersen, expounds, with the same unflagging patience with which he helped to develop, all the minute points of detail which must be observed before the apparently simple results can be obtained. The section on results, also largely by Dr. Pedersen, is fairly short, which is right, since these are all in the literature and a full bibliography is given, whereas much of the technical part is published here for the first time. The greatest interest of all, perhaps, is contained in the section on rotor design, where the succession of hopes, disappointments, and triumphs reads like a novel. Visitors have always heard of mysterious conferences with a "steam turbine expert from Stockholm" when a new rotor was in contemplation. The mystery man now seems to be revealed as G. Boestad. One wonders whether he is the artist responsible for the quite unearthly beauty of the modern rotor (see Fig. 97).

The book as a whole has both the advantages and drawbacks of a composite work. Every detail is written by someone who knows all about it, but despite the strongly unifying personality of Svedberg, it is not one of those books in which every word follows inevitably on its predecessor. There is too much repetition, due partly to the otherwise attractive method of covering the ground first in outline and then in detail, partly to imperfections in the scheme of classification or to different interpretations of it by different authors. But in spite of this, and of the fact that it is a standard work of reference, the book is quite surprisingly easy to read. As a work of reference it might profitably have incorporated some of the invaluable hints contained in a typed document known as "Watson's Manual", such as what to do when the rotor temperature soars skyward, or the oil pressure suddenly vanishes. A more serious omission is the account of results obtained with air-driven ultracentrifuges, but as explained in the preface they have been included in the bibliography.

It is interesting to speculate on the future of the ultracentrifuge. So far as resolving power goes, not much more can be expected, even if refinements such as synchronized light-source, oval cell-holes, etc., are introduced. The power-consumption has been greatly diminished recently, but it now seems scarcely worth pushing it much lower. The capital cost remains, as always, high, being due more to the large number of accessories than to any single item. The ease of operation, including measuring the results, is now as good as could be desired if one is content to guess the base-line instead of measuring it; but it would be a great convenience if some means could be found for obtaining the true base-line without an extra run and for automatically subtracting it. On the whole, therefore, no sensational technical developments are to be expected. What about applications? It can be safely predicted that whenever a new protein is isolated (or is thought to have been isolated) it will be sent as now to an ultracentrifuge centre for study of its homogeneity, sedimentation constant, molecular weight, and possibly *p*H-stability curve.

It is possible that purely ultracentrifuge researches will give place almost entirely to this monotonous but highly necessary work as the rate of isolation of new proteins increases and the general laws of protein aggregation cease to have any more surprises; but the ultracentrifuge will also continue to be of importance as an adjunct in other research, for example, in any experiments on the action of reagents on proteins or in the study of pathological sera, plastics, etc., which are highly complicated subjects still in their infancy. If I dare predict a negative, it is that the preparative separation of the lower molecular proteins by ultracentrifuging will never be a useful method, although the apparatus for it already exists. The separation of high-molecular substances like the viruses is another question, and here the method has thoroughly established its usefulness.

Finally, a word on the still controversial question of air-drive versus oil-drive. Svedberg originally chose the latter on grounds of efficiency, and the figures quoted in his book amply justify the choice; but the question of drive has become coupled with three other questions, namely horizontal or vertical axis of rotation, material of rotor, and hydrogen or high vacuum as surrounding medium. For optical measurements the horizontal axis is better, while for preparative purposes the vertical one is essential. The two rotor materials are steel and duralumin. Steel gives slightly higher resolving power at the cost of a large increase in strength of casing and foundations, in power required to accelerate and in thickness of bearing and therefore power required to drive. Since the air-drive is too inefficient to be used satisfactorily with steel, the exponents of it have had to develop the possibilities of duralumin, but have reaped the latter's own advantages in compensation. One of these, the small bearing shaft, has made it practicable to run in high vacuum instead of hydrogen; and apparently if the vacuum is good enough it is definitely superior to hydrogen. Thus in every way except resolving power and possibly length of life, duralumin is superior to steel; but for low-molecular proteins resolving power is of cardinal importance, so that until some new material is produced, steel will continue to be used where the appreciable difference in capital cost can be afforded.

J. St. L. Philpot.

FUN AND PHYSICS

Mr. Tompkins in Wonderland

Or Stories of *c*, *G*, and *h*. By Prof. G. Gamow. Pp. x+92. (Cambridge: At the University Press, 1939.) 7*s*. 6*d*. net.

Mr. TOMPKINS was a bank clerk seeking distraction at the end of a heavy day. Bored almost to tears by the inevitable Hollywood stuff at the 'movies', and attracted by the title "Space, Time and Cosmology" which he thought might offer something in the Jules Verne vein, he drifted into one of a series of lectures at the local university on topics in modern physics, and that was where his troubles began. He did not understand the lecture. In fact he was not able to follow it sufficiently well even to misunderstand it, and retired to bed in that state of mental depression which is not an unusual after-effect of attendance at lectures on mathematical physics. His rash experiment, however, gave rise to the series of dreams, one might almost say nightmares, retailed in the first half of the book. The second half contains the lectures out of which the troubles arose.

In his dreams Mr. Tompkins finds himself in a succession of universes in which the fundamental natural constants—which in our universe are, fortunately, either so immensely large or so extremely minute that only mathematical physicists need to worry about them—have assumed values which bring their more remarkable consequences under direct observation. In some, that natural "speed limit", the velocity of light, is reduced to ten miles per hour; moving objects become unbelievably flattened; watches gain or lose in a most puzzling way, and a host of other "relativity effects" disturb the equilibrium of the unhappy little bank clerk. In others the "quantum-constant" swells to 1 erg sec. (surely not 1 erg/sec. as is stated in the text) and produces curious consequences in a game of billiards. In yet another the "uncertainty factor" assumes finite proportions, and a frightened gazelle dashing through a grove of bamboos emerges as a diffraction pattern. For details of Mr. Tompkins's adventures in these strange worlds the reader must consult the text.

In a world where popular expositions of the ideas of modern physics have been almost as plentiful as blackberries, Prof. Gamow has hit on something quite novel; and—incidentally—has by his dedication forestalled all possible criticism, for what reviewer could have the heart to comment adversely on a book dedicated jointly to Lewis Carroll and Niels Bohr? If Mr. Tompkins's adventures are not quite as amusing as those of the immortal "Alice", nor his "Wonderland" anything like so convincing as hers, that is because the author's purpose is didactic, and his imagination fettered by his equations. Truth, as portrayed in modern physics, is distinctly stranger than fiction, and the 'wavicle' can never hope to rival the grim reality of the Jabberwock. It would be difficult to imagine any better way of gaining a glimpse of the strange world in which the mathematical physicist lives, during business hours, than by accompanying Mr. Tompkins in his adventures.

The "dreams" collected in this volume first appeared in the pages of *Discovery*, and it is interesting to note how, even during the course of their publication, the outlook of modern physics changed. We do not know whether Mr. Tompkins was disappointed, or relieved, to be informed by the professor towards the end of the book that the closed pulsating universe in which, in his first adventure, he so narrowly escaped an extremely "stuffy death" was but a nightmare after all, and was no longer regarded as having any physical reality. However, as by this time Mr. Tompkins was busily engaged in courting the professor's daughter, he had possibly ceased to be interested.

The illustrations which enliven the pages of the text have a somewhat smudgy appearance, as if they were suffering from a rather large "wave of indeterminacy". Perhaps this is intentional, but the effect is not attractive. Prof. Gamow's stories fully deserve preservation in book form. Mr. Tompkins, now safely married, no longer needs the dubious excitement of university lectures. Should, however, his father-in-law's expositions, now, no doubt, transferred to the domestic circle, induce still further adventures, we hope Prof. Gamow will be at hand to report them.

J. A. CROWTHER.

CHEMICAL APPLICATIONS OF SPECTROSCOPY

Chemical Spectroscopy
By Prof. Wallace R. Brode. Pp. xi + 494. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 36*s*. net.

IT is unquestionable that this book will have a wide appeal. Everyone engaged in spectroscopy, no matter what branch, will find something of interest and perhaps some useful advice and suggestions within its covers; everyone interested to know 'the how, the why, and the wherefore' of spectroscopy will find an answer to the majority of his queries. Some idea of its scope will be gathered from the chapter headings: introduction; atomic and molecular spectra; emission spectra (apparatus); qualitative analysis, spectrum tables, and standard samples; quantitative analysis; resonance and chemical structure; absorption spectra; absorption spectra (apparatus and methods); application of absorption spectra data; infra-red and Raman spectra; theory and description of colour; laboratory experiments; theory and practice of photography; equipment and arrangement of a spectrographic laboratory. In these chapters are laid down the fundamental theory and practice of spectroscopy, interspersed with valuable information on technique, on recording of spectroscopic data, on teaching spectroscopy, and on the sources from which spectroscopic apparatus and materials are procurable.

But these topics occupy only 313 pages. What of the rest of the book? It is given over to three things. First, a bibliography of books on emission and absorption spectra, followed by a list of 123 references to the most important original publications. Then come 120 pages (pp. 327–446) of spectral data arranged in tabular form. These tables, all that a student will require, give persistent lines by wave-length from 1850 A. to 7950 A.; the persistent lines of elements (in alphabetical order); the principal lines by wave-length from 2000 A. to 7998 A.; the principal lines of seventy-two elements (in alphabetical order), with ionization states, intensities of arc and spark spectral lines, wave-lengths of control lines and of lines from other elements, the presence of which in a sample would give interference and probably vitiate results; spark spectrum of air; principal lines of discharge spectra of ten elements (alphabetized); Fraunhofer lines in the sun's spectrum; various conversion tables. Finally, there are thirty-five full-page charts which appeal because of their usefulness—and their novelty. They show the iron spectrum from 2310 A. to 5090 A., and on them are marked identified iron lines and the indicated positions of the principal lines of other elements. These charts are "intended for use as a projection screen or for the superposition of an enlarged strip of the unknown spectrum and adjacent iron comparison spectrum". We must congratulate Prof. Brode on these tables and charts and pay admiring tribute to the industry and patience which their compilation has required.

The book contains a very large number of diagrams and photographs. Whilst, generally, these are very good, there are certain criticisms which must be made. The diagrams are characterized by a neatness and compactness which quite frequently results in the reproduction of diagrams on such a reduced scale as to make them rather difficult to examine, particularly as lettering is sometimes so small as to necessitate re-focusing the page for comfortable reading (for example, Figs. 4.4 (p. 68), 8.19 (p. 165), 9.11 (p. 208), 12.33 (p. 272)). Many photographs of apparatus are not too well reproduced, they are slightly fuzzy, and it is questionable if photographs of apparatus without diagrams of the optical system (there are several) will mean very much to a beginner. Some of the spectrograms lose clearness and definition by being reproduced on such a small scale (for example, Figs. 3.30 (p. 54), 4.6 (p. 71), 12.8 (p. 246)).

This book is essentially a practical book, and those who go to it for treatment of the theory of spectra will find it disappointing. The author has limited his discussion of theory to very concise statements on fundamental points. Particularly is this so with respect to his treatment of infra-red and Raman spectra. Whilst there is no doubt that these spectra constitute a field of their own, it is to be regretted that, since the author has elected to include them, he did not extend this chapter so as to give more detailed information on the specialized technique required for their study, concluding with a short account of the scope and utility of each when used separately and when the data from both are correlated. A detailed discussion would not have been necessary, and yet the undoubted success of these methods in the elucidation of molecular structure constitutes an important branch of chemical spectroscopy. But perhaps, on the whole, it might have been preferable to have omitted their discussion altogether.

Chapter xii, which deals with laboratory experiments, merits special attention. The exercises commence with the calibration of a spectrograph and then go on to the qualitative and quantitative determination of elements, the measurement of visible and ultra-violet absorption spectra, and the use of the photronic cell. The exercises, perfectly straightforward in themselves, are described in a most complete, careful, and attractive way, and will prove extremely useful as a basis for an elementary experimental course in chemical spectroscopy. The only criticism which may be made is that these exercises can, however, only be carried out when there is available in the laboratory a considerable quantity and range of spectroscopic apparatus.

No book of this size and importance can be expected to be entirely free of errors or devoid of sections or features to which some measure of adverse criticism can be applied. This book is no exception. But the feeling left in the mind of the reviewer after perusing it is that the book, although rather expensive, is a welcome and timely addition to the literature of the subject and can be thoroughly recommended.

W. ROGIE ANGUS.

HUMAN EMBRYOLOGY

The Essentials of Human Embryology
By Prof. Gideon S. Dodds. Second edition. Pp. ix+316. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 20*s.* net.

AS was to be expected in a work on human rather than comparative embryology, the second edition of Prof. Dodds's text-book, which is intended mainly for medical students, does not differ greatly from the first, published nine years earlier. Many of the chapters are little if at all altered, but there are certain sections in which changes have been introduced as a result of recent researches. These relate more particularly to the early stages of development, the testis and ovary, the placenta, the ages of embryos, the formation of bone, the pharynx and its derivatives, the blood vessels, and the growth of nerve fibres. Moreover, the chapter on ovulation, menstruation, and pregnancy has been almost entirely rewritten.

In the fourth chapter there is an interesting account of the four very young ova known as the Miller, Bryce-Teacher, Peters and Spee ova. The section on the determination of the age of embryos includes useful tables illustrating the growth, and one of these, which is supplied by Dr. Streeter and hitherto unpublished, includes ages below eight weeks, the figures being based upon young human embryos compared with accurately timed monkey embryos. It is to be noted that in the chapter on the nervous system there is included a brief account of Speidel's recent research on the growth of nerve fibres in the web of the tail of the tadpole.

The chapter on ovulation and the related processes deals with certain matters which are not beyond dispute, and the statements made are not always quite accurate. Thus, in the formation of the corpus luteum, the follicular cavity is partly filled in by the ingrowth of connective tissue and vessels from the wall and not simply by the hypertrophy of the epithelial cells, as here described. Further, the hæmorrhage which takes place before œstrus in the bitch cannot correspond to the inter-menstrual bleeding of women occurring at about the time of ovulation, since the latter process in the dog does not supervene until œstrus, and it is well known, as pointed out by Heape, that the bitch will not usually receive the male until external bleeding is quite or nealry over.

Such defects as those indicated, however, must not be held to detract from the general usefulness of the book. F. H. A. MARSHALL.

A SKELETON HISTORY OF SCIENCE

Science since 1500
A Short History of Mathematics, Physics, Chemistry, Biology. By H. F. Pledge. Pp. 357 + 15 plates. (London: H.M. Stationery Office, 1939.) 7*s*. 6*d*. net.

THIS book gives a very compact summary of the history of the chief sciences during the period indicated in the title, and also some retrospects covering earlier periods. The mode of presentation varies. Some of the chapters follow the main divisions of science, others confine themselves to some special problem, while others again are rather mixed bags the contents of which are strung together on somewhat slender threads.

The attempt to crowd so much into a single volume inevitably involves large gaps. The principal weakness of the book lies, however, in its inclusion of too much, rather than of too little, in the allotted space. The actual text consists of little more than 300 pages, and there is an index of 27 double-column pages listing some 3,000 names and subjects. In the circumstances, we have something like a skeleton rather than a living body. The various catalogues and handbooks published by the Science Museum are all of them more or less helpful. The present volume is probably the most ambitious, and probably one of the least helpful, of them all. The claim that the book is suitable for the general reader, for the beginner, etc., cannot be seriously sustained. If this was really one of the author's aims, then he should have reduced the number of facts dealt with, and thereby made room for more adequate explanations, so as to make the dry bones live. Additional space for expository purposes could also have been gained by omitting most of the illustrations, which are more curious than important, and some irrelevant matter.

It seems odd that Mr. Pledge, who makes quite severe demands on the reader's previous knowledge of science, should have refrained from assuming an elementary knowledge of European geography, and considered it necessary to devote 12 pages to maps and tables showing the birthplaces of men of science. I have not checked their accuracy, but one error attracted my attention because it is repeated in the main text. Mr. Pledge asserts twice that Spinoza was not born in Holland (pp. 51f.). But he was; namely, in Amsterdam. Again, Mr. Pledge sacrifices two pages to a facsimile and translation of a passage from a thirteenth-century Hebrew manuscript in which motion is described as a cause of heat. To judge from the section in which the facsimile is inserted, it appears to be regarded by Mr. Pledge as an anticipation of the kinetic theory of heat. Actually, the passage is irrelevant, as it has no bearing on the question of *molecular* motion, nor on the question whether heat is a kind of substance or a kind of energy. Incidentally, it may be pointed out that the facsimile is printed upside down!

Mr. Pledge does occasionally depart from the narrow path of bare summary. But his remarks, in those cases, strike one as tendentious and misleading, or at least as very questionable. For example, in a chapter on early mathematics, the notion of infinity is dealt with in a manner which betrays a curious mixture of ideas pertaining to mathematics, sociology, and theology, and the net result is summed up in the following delectable statement: "For the step-by-step communion with the infinite by a series of sacraments, science has substituted the step-by-step communion with it by a series of hypotheses and experiments. But the infinity remains." What has this to do with the mathematical conception of infinity? Again, here is Mr. Pledge's amusing incursion into comparative psychology: "the domestic dog appears to believe that he can impart motion to his master infectively by fervent imitation of the actions of going for a run"! Mr. Pledge's adventures into the realm of philosophy are on the same level of infelicity. The terms "philosophy" and "philosophical", etc., are used in such varied and nebulous senses that one is made to wonder what he really means by them; and, even apart from this vagueness, his quasi-Comtean remarks about the relation between philosophy and science are made in defiance of the fact that eminent thinkers like Descartes, Leibniz and Kant were men of science as well as philosophers, and that the same sort of combination is found among such contemporaries as Whitehead, Russell and Eddington.

Finally, reference may perhaps be made to another kind of crudity which rather mars the book, namely, the use of such phrases as "the Jew, L. Kronecker", the "Jew convert" Cantor, etc. Mr. Pledge most probably does not mean to be unfriendly, but the use of such expressions reminds one of a significant remark made, more than a hundred years ago, by a journalist of distinction. Some people, he protested, hate the Jews merely because they are Jews, some tolerate them in spite of their being Jews, and some even like them just because they are Jews; but nobody ever seems to forget that they are Jews! A. Wolf.

VISCOSITY AND MOLECULAR STRUCTURE

By Dr. H. Mark and R. Simha

THE development of the molecular theory of matter has as a consequence that an increasing number of empirical constants, by which one characterizes the behaviour of a macroscopic sample, are brought into quantitative relation with the molecular structure of the material. For example, it has long been known that the *index of refraction* can be connected with the *mobility of the electric charges* in a given substance, and therefore can be used to determine the electrical polarizability of the molecules in a quantitative way. Similarly, the *dielectric constant* can be used to get quantitative information on the *distribution of the electric charges* in the molecules of a given substance, and it was P. Debye, especially, who succeeded, together with a number of collaborators, in establishing a quantitative theory which combines the macroscopic empirical constant with the molecular properties.

Recently, it seems that another quantity, which has been used for some time to characterize a given system from an empirical point of view, must be understood and evaluated from the angle of the molecular theory of matter. This is the *internal friction* or *viscosity* of solutions. This property has been accounted for in ideal gases by the kinetic theory of gases, by consideration of the masses and velocities of the individual molecules and their irregular collisions. But our knowledge of the viscosity of condensed systems had not progressed so far, although it was obvious that much valuable information would be obtained if viscosity could be interpreted kinetically.

During recent years, some special developments have been particularly favourable to the solution of this problem. The most important of them are : (1) the development of a quantitative theory of liquids ; (2) the accumulation of a large amount of experimental data on high polymeric substances and their solutions, and the development of the ultracentrifuge, which enabled us to get independent information on high molecular compounds.

This progress encouraged the attempt to trace the viscosity of solutions, and especially of solutions containing high molecular substances, back to the fundamental properties of their elementary particles, namely, to the size and shape of the molecules and to their power to fix a certain amount of solvent on themselves. Such attempts were started about fifteen years ago from different points of view. An increasing number of scientific investigators have turned to the subject since then, and we are now obtaining a first insight into the connexion between the viscosity of a solution and the fundamental properties of the dissolved material. It is not suggested that any finality has been reached in this field, but it seems that experimental conditions which are necessary to get trustworthy information have been worked out, and that the results which can be presented to-day are consistent among themselves and agree with the findings by other experimental methods.

It may therefore be appropriate to enumerate briefly the different essential steps which have led to this kinetic elucidation of viscosity and to present a few results which may be presumed to have reached a certain degree of reliability. It may be that in the future such results will have considerable interest in biochemistry, physiology and chemical industry.

Early Fundamental Investigations

Einstein[10] was the first to derive with incomparable clarity an equation showing how spherical particles which are dispersed in a liquid would raise its viscosity. He found, so early as 1905, that the increase of internal friction is proportional to the total amount of dissolved volume, but surprisingly independent of the degree of dispersion. A few large spheres produce the same viscosity increase as many small ones, provided their total volume remains constant. A few years later, Bancelin[1] and Sven Odén[36] confirmed experimentally Einstein's theoretical results.

Having received experimental confirmation, the Einstein equation could be used to determine the total volume of the dissolved phase, that is, the degree of swelling or solvation which the material undergoes during solution. For example, it was found that a molecule of cane sugar carries with it about five or six molecules of water tightly fixed upon its surface during the diffusion in the liquid.

But the combined theoretical and experimental results seemed to block any possibility of getting information concerning the size of the dissolved particles, because it was found that the viscosity should be independent of this quantity.

However, during the following years an increasing number of empirical facts showed that there evidently was some relation between particle size and viscosity in quite a number of cases. Measurements of Biltz[3], Berl and Buttler[2], Hatschek[21], Duclaux and Wollmann[9], Ostwald[30], and Staudinger[35] gave indications that the viscosity of very dilute solutions of many typical high molecular substances decreases if one degrades the original material, and that it is increased if one raises the molecular weight. As this is apparently in disagreement with the Einstein equation, it was concluded that these substances do not behave as spherical particles.

From here on a double development became necessary: (*a*) to accumulate more reliable and quantitative empirical data in order to have a sound experimental background; and (*b*) to derive theoretical equations for non-spherical particles.

THE PROBLEM OF NON-SPHERICAL PARTICLES

Much successful work was contributed in both directions. It was especially Staudinger and his collaborators who extended viscosity measurements considerably, investigating systematically the influence of molecular weight, concentration, temperature, and solvent; and they established an empirical rule, the well-known viscosity equation of Staudinger[35].

This equation states that the viscosity increase due to the dissolved substance is proportional to its molecular weight, provided that the solution is sufficiently diluted. Very careful viscosity measurements by Meyer and v. d. Wijk[29], and by Kraemer and Lansing[25] showed, however, that this relation is not exact but is subject to certain deviations. But it can be safely regarded as being a valuable rule for the estimation of molecular weight, and it has proved to be very fruitful for further progress in this field.

While this experimental material was accumulating, a series of successful attempts to develop equations for non-spherical particles was made. Jeffery[23] was the first to start this development. He was followed by Eisenschitz[13], Boeder[5], Haller[20] and Kuhn[27]. These investigators developed equations making it possible to calculate the viscosity increase due to longish particles, as the Einstein equation did for spherical particles. Obviously these relations were expected to explain theoretically the Staudinger equation, but at first sight there seemed to be a lack of agreement.

The Staudinger equation states that the viscosity increase is proportional to the molecular weight, while hydrodynamics indicate that it is proportional to the square of the molecular weight. Guth and Mark[18] proposed qualitatively an explanation for this discrepancy, but Kuhn[27] was the first to work out a complete and consistent theory.

If one assumes that the dissolved particles are *not stiff rods but flexible threads*, the experimental findings and the theoretical equations harmonize in a manner which shows that the idea of long flexible chains rolled or wound up to a more or less cluster-like unit is the right way out of the dilemma.

DEVELOPMENT OF THE HYDRODYNAMICAL METHOD

To get a final check on the value of this explanation, further experimental and theoretical work was undertaken. Eirich, Bunzl and Margaretha[12] studied systematically the behaviour of model suspensions with particles of exactly known size and shape. Glass, silk, rayon, mushroom spores, bacteria, microscopic crystals, etc., were used; the size varied from 1μ to 100μ diameter, the shape from spherical particles to rods with an axis-ratio of about 50. The viscosity of proteins was carefully investigated by Fahry and Green[14] and by Polson[32]; the latter giving an extensive comparison of the data obtained by viscosity measurements with the results of the Svedberg ultracentrifuge. At the same time Houwink and Klaassens[24], Kraemer and Lansing[25], Bogue[6], Kratky and Saito[26], and others contributed valuable experimental material on different high polymeric substances.

The hydrodynamical treatment was pushed forward by Guth[17,19], Huggins[22], Kuhn[27], and Simha[34], in the direction of both spherical and non-spherical suspensions, taking into account the influence of higher concentration and of the Brownian movement.

Another group of recent articles represents comprehensive work aiming at the comparison of all available data and their survey from a common point of view. Sakurada[33], and particularly Bredee and de Booys[7], and Huggins[22], have contributed in this direction.

CONCLUSIONS

As the result of the experimental and theoretical work briefly described above, some data contained in the following tables can be usefully considered. They show that although we still have to consider that we are in an early stage of the complete molecular interpretation of viscosity, a number of very interesting molecular constants can be derived from such measurements.

Table 1 shows the size and shape of some protein molecules as determined by viscosity measurements, and at the same time the corresponding values obtained with the Svedberg ultracentrifuge.

TABLE I. SIZE AND SHAPE OF PROTEIN MOLECULES IN AQUEOUS SOLUTION*

Substance	Molecular weight		Axis ratio	
	from viscosity	from ultra-centrifuge	from viscosity	from ultra-centrifuge
Ovalbumin	41,800	42,000	8·5	3·8
Hæmoglobin	70,300	68,000	5·9	3·8
Serum albumin	71,800	70,000	9·8	4·9
Homarus hæmoglobin	793,000	800,000	—	—
Tobacco mosaic virus	$17{\cdot}43\times10^{6}$	—	36·9	—

* Compare refs. 4, 7, 14, 16, 28, 32.

TABLE 2. MOLECULAR WEIGHT, SOLVATION AND SHAPE OF SOME CELLULOSE DERIVATIVES*

Substance	Molecular weight	Volume of the solvated particle as multiple of the dry volume	Deviation from the spherical shape†
Nitrocellulose	500,000	345	2·5
,,	150,000	121	3·7
,,	40,000	40	2·6
Cellulose acetate	50,000	97·5	3·0
,, ,,	14,000	31·3	3·2
,, ,,	6,400	13·2	2·1

* Compare refs. 2, 7, 8, 9, 15, 35.
† Spherical shape is characterized by the value zero.

It can be seen that, as regards the size of the particles (molecular weight), the two methods agree fairly closely, while viscosity gives a higher axis-ratio than the ultracentrifuge.

Table 2 contains similar information on the molecular weight, solvation, and shape of some cellulose derivatives. In this case no experimental data from the ultracentrifuge were available, and therefore an experimental check of the values is not possible. However, other methods (osmotic pressure, diffusion, etc.) confirm the above values and show that they certainly reflect to a considerable extent the true conditions in these high molecular suspensions.

TABLE 3. MOLECULAR WEIGHT, SOLVATION AND SHAPE OF SOME POLYSTYRENE SAMPLES*

Molecular weight	Volume of the solvated particle as multiple of the dry volume	Deviation from the spherical shape†
280,000	205	7·3
220,000	80·5	5·7
23,000	15·4	3·1
2,400	2·65	0·4

* Compare refs. 7, 31, 33, 35.
† Spherical shape is characterized by the value zero.

TABLE 4. SOLVATION OF DISPERSED SUBSTANCES WITH APPROXIMATELY SPHERICAL PARTICLES*

Substance	Degree of solvation (per cent)
Mushroom spores	nil
Colloidal sulphur	nil
Kresol-formaldehyde-resin	10–40
Cane sugar	50
Ovalbumin	120
Gamboge	800
Gelatine	1,000–2,000

* Compare refs. 1, 4, 6, 7, 12, 14, 24, 32, 36.

Similar data concerning some samples of polystyrene are given in Table 3. They are equally supported by the results of other experimental methods.

Tables 2 and 3 show that with increasing molecular weight the solvation of the substance investigated increases, and in the case of styrene the deviation from the spherical shape also assumes higher values.

Table 4 gives the solvation of some systems the particles of which are approximately spherical, and shows that different materials behave very differently as regards their power to absorb certain amounts of solvent and to carry them about during their molecular movements.

If account is taken of the fact that it is very difficult to get any trustworthy quantitative information on size, shape, and solvation in the region of such high molecular weights, it will certainly be admitted that viscosity measurements provide a very valuable and welcome means of obtaining quantitative information on the molecular structure of such materials.

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PLANT HUNTING THROUGH THE CENTURIES*

BY F. KINGDON WARD

IN a sense, man has been searching for useful plants ever since he first appeared on the earth. Even in his hunting days before the end of the Ice Age he probably supplemented his diet with berries, seeds and roots. But for our present purpose we may ignore man before he became a cultivator, merely noting that even in those remote days he was a plant hunter.

We may perhaps picture primitive man slouching painfully across that early European landscape, haunted by the spectre of hunger, a child of sudden overwhelming impulse, fearful and bewildered, clutching, famished, at a handful of grass seeds or coloured berries, gnawing tough fruits, or chewing leaves. Through these bitter centuries he was learning gradually the first lesson man was compelled to learn in his dealings with the tremendous, infinitely old vegetable kingdom which he was destined one day to control: the difference between cellulose and starch or sugar, the difference, that is, between the structural materials of plants and the products they manufacture and set aside for future use; the cell wall and the cell contents. For cellulose is insoluble and therefore useless to man as food, since he cannot assimilate it; but sugar is soluble and starch is easily converted into sugar. Only the plant store-houses—fruits and seeds and certain usually underground parts and growing points—contain available food. The object of cultivation, besides being a matter of greater convenience, is to increase the soluble cell contents and eliminate as much as possible of the framework.

To get the botanical exploration of the world into perspective, it is necessary to go back eight or ten thousand years. The outline of the world was not then very different from what it is to-day. But there have been great changes in the mantle of vegetation since then, changes in the relative positions, and in the extent of forest, steppe and desert which are ultimately dependent on rainfall. It was vegetation, and hence climate, which determined not only which direction wandering man should take, but also where he should first begin to settle.

Although man must have been a hunter before he became a herdsman and a husbandman, through long ages all three must have existed together in different parts of the then habitable world. Man could have hunted only on the steppes; he could not have lived in the desert, and in the forest he would have been a complete vegetarian. It would therefore be misleading to divide the time period into the three ages of hunting, herding and husbandry. Broadly speaking, herding suggests a nomadic, cultivation a settled, life. But there are many villages in Tibet to-day where no crops are grown, while in many parts of the world agriculture is itself nomadic. In densely forested regions the same patch of ground can only be cultivated at long intervals, and there comes a time when the village has to move. Abandoned village sites are common, for example, in far northern Burma.

Since we are dealing with a continuous evolution, no classification of the plant exploration period on a time basis can be other than arbitrary. Nevertheless, the following rough guide may be found convenient, though it involves a good deal of overlapping.

(*a*) *The Search for Food Plants.* Prehistoric period, from the beginnings of cultivation to the invention of writing, from about 7000 B.C. to about 4000 B.C.

(*b*) *The Search for Economic Plants, other than staple foods, but including many food plants of secondary importance.* Historic period, from 4000 B.C. to the discovery of the New World in A.D. 1492.

(*c*) *The Search for Garden Plants.* Modern period from A.D. 1492 to the present day.

This corresponds to some extent with three successive steps in the evolution of civilization, namely, (i) the search for economic plants, or as it is called to-day, raw material; (ii) the large-scale cultivation in any convenient part of the world of economic plants; and (iii) the large-scale manufacture of synthetic products from simple vegetable raw material. So we take up the story of plant hunting at the end of the pre-agricultural age; the earliest plant hunters sought food plants.

Cultivation must have arisen independently in several centres; settlement was the basis of civilization. The primitive tribes of the eastern Himalayas, although new-comers (their chief crop is maize, which was unknown in Asia before the discovery of America) show traces of what early agriculture may have been. In the vicinity of Abor and other villages, fruit trees such as Artocarpus, peach, cherry, Citrus, quince, are much commoner than elsewhere, showing how settled people eat the fruits and spit out the seeds, which germinate in the village clearing.

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* Substance of a course of lectures delivered at the Royal Institution on January 16, 23 and 30.

In the Mishmi Hills, the medicinal herb *Coptis Teeta* grows in the forest, above the highest cultivation. The natives clear the ground, cut down a few trees, and encourage the Coptis by stifling opposition. These tribes also show how from very early times man has used vegetation in its raw state, as timber, etc. The use of bamboos for water-tubs, lianas for ropes, or the fibrous bases of palm leaves for cloaks are examples. The first thing man ever made for himself was a wooden (cellulose) club. One of the latest things he has provided himself with on a vast scale is also made of cellulose—nitro-cellulose, the basis of many high explosives.

The natural distribution of plants over the earth has until recently been a decisively limiting factor in man's economy. Until the exploration of the world was far advanced, the people of Malaya had no chance of cultivating Brazilian rubber, nor the people of Brazil of cultivating Arabian coffee. Nor were these substances required in bulk. Not only are the plants of different parts of the world different, even for the same climate, but also they are of unequal value. Nowadays this unevenness of distribution can be levelled up by transporting any plant from where it grows naturally to any part of the world where it will grow. Plants regarded as of less importance are swept away to make room for huge crops of one kind, such as rubber, quinine, sugar cane or tung oil. The vegetation of the earth is everywhere being rapidly altered by man.

It has been shown by de Candolle, and more recently by Vavilov and others, and endorsed by antiquarians, that the earliest civilizations began in those regions whence most of our oldest cultivated crops have been derived. But nowadays the great centres of civilization bear no relation to, or are quite independent of, the original homes of the cultivated crops. That is a very significant fact.

After food, man's chief need was clothing. When animal skins became rarer, he turned to cellulose, and wore leaves. To-day most of the world's clothing is made of cellulose products such as cotton and rayon. The art of weaving is older than that of writing.

In the Ancient World new ideas diffused slowly, but they were quickened later as the result of pilgrimages, campaigns like that of Alexander, and trading. When civilization was disintegrating all over the world between A.D. 1050 and A.D. 1250, owing to the attacks of barbarians, cellulose came to the rescue with the increasing use of paper, which made books possible. Knowledge was preserved without accumulating error, and degenerating into legend. The earliest paper—papyrus (pith), *Aralia japonica* (pith), and palm leaf—was practically pure cellulose and useless for books. But the invention of paper which would take print was a fundamental step in the forward march of civilization. Printing itself was of less importance than paper; it increased the speed of diffusion, without any corresponding increase of accuracy, so that myths were as readily propagated as truth; for example, in modern times the widely believed story of mummy wheat germinating.

From the beginning, agriculture has had a disastrous effect on the natural cover of vegetation, and one of ever-increasing severity, especially in areas of natural grassland and in mountainous forested country where shifting cultivation is practised. The plough has proved one of the most destructive weapons ever put into the hands of man. Within the last few centuries pastoral man has become almost as destructive as agricultural man, as a result of cutting down forest to increase the area of pasture. The damage is clearly seen in many parts of the eastern Himalayas, where the local climate is being altered, and much land becoming derelict.

Two hundred years after Marco Polo's journey, the overland route through Eurasia was virtually closed. Diaz then rounded the Cape, and Columbus discovered the New World. As a result, the age of maritime exploration began, and more was learnt of tropical than of any other type of vegetation. The coasts and the estuaries of great rivers were explored. But for lack of roads, the interiors of the continents remained hidden, and it was not until the nineteenth and twentieth centuries, and the intensive search for gold, that the building of roads and railways made inland exploration possible. The historic voyages of the seventeenth and eighteenth centuries did nothing to make known the vegetation of the interiors of continents. The interior of Africa, of Australia, of Central Asia and of South America have been known to scientific men for little more than a century; the interior of Tibet, and of New Guinea, for less than fifty years. Now that transport problems have been solved, new obstacles in the form of 'national interests' are making scientific exploration over considerable portions of the least-known parts of the world increasingly difficult.

After food and fibre plants, man sought dyes, drugs, soap, scents and such-like things. While searching for food plants he may have discovered soothing or uplifting properties by chance, for example, opium poppy seeds, which the Mishmis eat, tobacco, hemp. Fermentation of his stored grain taught him the use of alcohol. In modern times, oil-producing fruits and seeds are in great demand. The plantation industry grew up with the Mechanical Revolution; raw material was needed to feed the machines. When the topography of the world had been mapped, the mapping of the vegetation and of the rocks followed. From the beginning, unusual looking plants attracted man's attention ; and it was but a short step to cultivate flowers. With the advance of civilization, horticulture took a prominent place. In spite of the intensive exploration of the world for new plants during the last 1,500 years, not one unknown economic plant of any importance has been newly discovered. Even tung oil and soya bean, than which few plants have come into greater prominence recently, were cultivated several thousand years ago. On the other hand, many beautiful garden plants have been newly discovered.

Apart from horticulture, perhaps five hundred species of plants are now cultivated on a commercial scale—a very small proportion of the total known flora. The tendency is to reduce rather than increase the number, as the chemist learns how to synthesize plant products. Thus coal tar dyes supersede vegetable dyes, although coal tar is itself, ultimately, derived from vegetation ; and better varieties of wheat drive out inferior varieties. The increasing cultivation of herbs for the herb drug market perhaps restores the balance.

Apart from the staple cereal and fibre plants, and the various sources of such things as cellulose and timber, the most important economic crops to-day are : rubber, soya bean, quinine, tea, coffee, cocoa, sugar cane, banana, tung oil, varnish tree (Rhus), tobacco, opium, sisal and jute. The chief supply of nearly every one of these is now far from its original source, often in a different continent, as coffee, rubber, quinine and sisal. This has been brought about at the expense of the original vegetation, as a direct result of the growing economic interdependence of mankind. But it only became possible when the main features of the world's vegetation were known. It is obviously an advantage that all men who want tea or soap should be able to obtain these things, rather than that they should be confined to the few ; but mankind is going through a period of intense economic readjustment in order to achieve this desirable end of plenty of everything for all. There is a further conflict between what men need at any given level of civilization, and what 'interests' can persuade them to want.

The world is far from being botanically explored yet. But much of what remains to be done is predictable, thanks to increased knowledge. This enables us to carry on the work more systematically. There may not seem to be the same careless rapture in exploring a given region for largely predictable plants that there might be in wandering through unexplored worlds. But lack of knowledge is a real handicap. It is because we see the past world through eyes which have been opened that it looks romantic. To contemporary man the vegetation must have been confusing, exasperating and overwhelming. So far as plant exploration is concerned, the present is the age of the intensive specialized botanical explorer and the chemist.

PRESERVATION OF GEOLOGICAL RECORDS*

BY DR. M. MACGREGOR,

GEOLOGICAL SURVEY OF GREAT BRITAIN

THE preservation in a carefully documented and permanent form of geological records of all kinds is a matter which should be regarded as of the utmost importance, and the opportunity is taken here of stressing the need for conjoint action to deal with it. If the examples used by way of illustration are drawn entirely from Scottish sources, it is partly because they have come directly under my own observation and partly because the suggestions advanced may gain in cogency if their application to one particular region is emphasized.

The importance of preserving geological sections of outstanding or critical significance has long been recognized. These may be conveniently grouped into three broad, more or less arbitrary, categories. They may, for example, illustrate unique episodes in the history of the earth ; they may represent landmarks in the progress of geological thought or symbolize striking advances in our knowledge of geological processes ; they may, again, be sections that require re-examination and re-consideration from time to time in the light of modern research. For these and other reasons—historical, educational and scientific—the question of their preservation is a challenging one for all geologists.

These three categories may be very briefly dealt with. It would not be easy to select a more impressive illustration of the first of them than the little trial quarry at the roadside 3½ miles north-west of Inchnadamph, in Sutherlandshire (Geol. Surv. Photo. C. 2019). Here the basal beds of the Torridon Sandstone, containing wind-facetted pebbles, rest discordantly upon an eroded and weathered surface of Lewisian Gneiss. Not only does this section allow us a glimpse of a land-surface that existed in early Torridonian times, more than 500 million years ago, but also it illustrates clearly and diagrammatically the structural relations of two of the most ancient rock-formations known. It would be a great loss if the section were to be swept away during the road-widening schemes that are in contemplation, and assurances have been obtained that it will not be destroyed. Another striking example that may be adduced is the well-known "Fossil Grove" at Victoria Park, Whiteinch, now a museum under the care of the Parks Department of Glasgow Corporation (Geol. Surv. Photos. C. 3560–61).

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* Substance of an address prepared for the Conference of Delegates of Corresponding Societies at the Dundee meeting of the British Association.

Of sections falling within the second category two instances may be given. The first of these is the historic exposure in the River Jed, near Jedburgh, discovered by Hutton in 1787 and described by him as providing unassailable evidence for elevation of the land, followed by erosion, subsidence and a fresh cycle of deposition. The originality of Hutton's genius is perhaps nowhere more fully exhibited than in his interpretation of the Jed River section. This exposure (Geol. Surv. Photo. C. 3494), which shows the nearly horizontal sandstones and marls of the Upper Old Red resting unconformably on highly folded Silurian rocks, was in danger of being overgrown and obscured, but now, owing to the generosity of Provost Veitch, it has been largely cleared of vegetation and debris and a pathway constructed to it. The second example which may be quoted under this heading is the striated rock-surface on the south face of Blackford Hill, Edinburgh, known as Agassiz' Rock (Geol. Surv. Photo. C. 2079). This also is of historic interest, since it was during a visit to the locality in the latter part of 1840 that Agassiz recognized the grooved surface as the work of glaciers. A number of years ago the Edinburgh Town Council, at the request of the Edinburgh Geological Society, agreed to protect the rock-face with a railing and to erect a commemorative tablet.

Within the third category may be fitly included various sections on the slopes of Arthur's Seat, Edinburgh, which have from time to time been re-interpreted in the light of increasing knowledge. Some of these, on Salisbury Craigs (Geol. Surv. Photos. B. 928–9), were at one time in danger of being quarried away, but the whole area of Arthur's Seat is now a national park under the custody of H.M. Office of Works.

Clearly, however, the preservation of important or critical sections is only practicable in a limited number of cases, and in this connexion brief reference may be made to the exposures of fossiliferous clays and sands which were laid bare about 1868–69 in Cowden (or Cowdon) Glen, Renfrewshire, during the construction of a railway line between Caldwell and Neilston. James Geikie, Croll, Bennie and other geologists who examined the excavations came to the conclusion that the fossiliferous beds, with their mammalian and other remains, were deposited between two distinct boulder clays and were accordingly interglacial in age. Craig, on the other hand, claimed: (*a*) that much of the 'upper' boulder clay was due to landslips at the side of the valley bringing down portions of the 'lower' boulder clay over the laminated material; and (*b*) that where it was definitely *in situ* above the latter it was of a gravelly nature (with lumps of the underlying sediments) and owed its formation not to the action of ice but to that of water. While the interglacial age of these beds is now generally accepted, Gregory and Currie in 1928, after a review of the available evidence as presented by earlier workers and a critical examination of the vertebrate remains, concluded that the deposits were "post-glacial and probably Neolithic in age". The question is certainly an important one in its bearing upon the Glacial and post-Glacial history of the region. It cannot be discussed here, but the Cowden Glen sections will serve as illustrations of ones which we would much like to re-examine in the light of later work.

Perhaps the most important aspect of the problem, however, concerns the preservation in a permanent form of geological records in general. Although much has been accomplished in this respect, it is certain that a systematic and co-ordinated effort to deal more fully with the problem is both essential and urgent. Much valuable geological information can be obtained from excavations made for various purposes connected with industrial and allied undertakings, from boring and mining developments, from tunnelling and quarrying operations, from roadway and sewage schemes, from factory and housing extensions, and from temporary exposures in constructional work of all kinds. The machinery for dealing with shafts and borings for minerals more than 100 ft. in depth is already in existence, but in regard to the other operations enumerated there is a wide field not covered by any co-ordinated activity.

Much of the information that might be derived from such sources is lost, or is available only in a form that is difficult, and indeed often impossible, to interpret. Engineers and foremen in charge of constructional work, surveyors, well-sinkers and the like have their own special tasks and their own aims in view, and they cannot be expected to provide records in the form and with the detail required by the geologist. It is surely the duty of the latter to see that the exact information he needs is carefully collected and made available for purposes of research. This is done in the case of borings for minerals, and it seems essential that it should be done systematically in regard to temporary sections of all kinds.

The importance of such investigations and of their repercussions not only on scientific but also on economic problems is not sufficiently realized, and the opportunities they offer for adding to our knowledge are too often neglected. Certainly they will often be of small importance individually, but collectively they may well amount to an impressive body of valuable geological data. Their significance in the preparation of detailed geological maps need not be stressed. Temporary excavations have contributed much to our knowledge of the geological succession and structure in different areas, notably, so far as Scotland is concerned, around Edinburgh and Glasgow. On the other hand, it would be easy to cite examples of temporary exposures which were not examined and about which little or no information is now available. The cumulative loss to geology must be very considerable, and it is in the hope of minimizing it that the problem is raised anew. In the past, the preservation of records has been left too much at the mercy of accident, and it would seem essential to establish, or try to establish, some definite system of efficient safeguards.

Thus there are two objects to keep steadily in view. The first of these is the preservation, wherever possible, of sections of outstanding or critical significance. In a number of cases this has been secured through the co-operation and assistance of public bodies, and geologists must feel deeply indebted to these for their action. Private assistance has, as already stated, come to our aid in the case of the Jed River unconformity, while acknowledgment should certainly be made of the generous action of Major-General J. W. Stewart, when in 1930 he conveyed to the ownership of the Royal Society of Edinburgh the ground at Inchnadamph on which the Peach and Horne memorial stands (Geol. Surv. Photos. C. 3550–51). Where preservation of important sections is possible, however, appeals for co-operation and assistance will come more effectively from a committee representative of geological opinion throughout the country. One other thing must be said in this connexion. It will not be out of place to suggest that geologists themselves are not always entirely free from blame in this matter, and that some restraint might be put on indiscriminate collecting at specially important and limited exposures.

The second and, in my opinion, the more urgent claim on our attention, is the preservation of carefully annotated records of exposures that are likely to be destroyed or to disappear, and of sections that are temporarily opened for examination. Included among the latter are excavations of all kinds as well as borings for whatever purpose these may have been sunk. The information they yield, scientific and economic alike, ought to be made available in a permanent and accessible form. To ensure this will require the active co-operation of geological and natural history societies and of university geological departments throughout the country, each responsible for a particular region and each reporting annually to a central organizing committee, either of the British Association or of the Geological Society. Brief abstracts of the work done in the different regions should be published at intervals, and these abstracts ought unquestionably to indicate where the fuller details are available, whether published or preserved in manuscript form. What is required is a register of new information derived from temporary sections and some system of ensuring that the full records, including any diagrams and photographs, are permanently retained. There is nothing extreme in this suggestion, and it ought to be possible to institute an efficient system of precautions against avoidable loss.

OBITUARIES

Sir Thomas Heath, K.C.B., F.R.S., F.B.A.

SIR THOMAS LITTLE HEATH, who died on March 16, was one of the most learned and industrious scholars of our time. He was born on October 5, 1861, the third son of Mr. Samuel Heath of Thornton Curtis in Lincolnshire. Sent to school at Clifton College, Heath went on with a foundation scholarship to Trinity College, Cambridge; and there, reading for double honours, he took a first in both parts of the Classical Tripos, and was twelfth Wrangler in 1882. Those years in Trinity are pleasant to look back upon. Henry Jackson was at his best; Acton, Glaisher and Robertson Smith intensified the atmosphere of learning; William Wyse, H. H. Turner, Henry Head and Alfred North Whitehead were among the undergraduates; James Gow was writing his "History of Mathematics"—a "convenient compilation", as G. J. Allman called it, but good enough to start Heath on the work of his life. He won his Trinity fellowship in 1885, as his eldest brother, R. S. Heath, afterwards professor of mathematics in Birmingham, had done two years before; and many years later the College awarded him its honorary fellowship, the most prized of all his many honours.

In 1884 Heath entered the Treasury, after heading the list in the Civil Service competition. He was a faithful servant, and, winning all the promotion open to him, rose to be permanent secretary of the Treasury and controller of the Civil List, conjointly with Sir John (afterwards Lord) Bradbury. After the War of 1914–18, when even the Treasury was greatly changed, Heath left it for the responsible but less arduous office of comptroller-general of the National Debt Office, which he held until his retirement in 1926; in the following year he published "The Treasury", a little volume of reminiscences of Whitehall. He was succeeded at the Treasury by Sir Warren Fisher; the two men had married sisters a few years before.

Heath was one of those fortunate men who live two lives in one, and enjoy both without neglecting either. Cayley was a busy London solicitor for many years, during which much of his finest work appeared; and Heath wrote one big and famous book after another, after the day's work in Whitehall was done. He took to Greek mathematics as an undergraduate; he came to be the acknowledged master of his subject in Great Britain, and to rank with Loria, Tannery and Zeuthen, next after Heiberg, the greatest Hellenist and historian of them all. While he was still an undergraduate, or very soon after, he wrote articles on Pappus and on "Porisms" for the "Encyclopædia Britannica" under Robertson Smith; and about the same time he published, in Henry Jackson and Ingram Bywater's *Journal of Philology*, a little paper on "The σ of Diophantus", an old puzzle which Heath succeeded no better in solving than others had done[*]. This and the article on "Porisms" were a foretaste of his first book, on "Diophantus of Alexandria", which came out in 1885, the year of his fellowship. This "youthful work", as Heath afterwards called it, won immediate acceptance, and ran out of print before long. It was written before Paul Tannery revised the text and redirected attention to the remarkable connexion between Diophantus and Fermat; twenty-five years later Heath republished the book, re-written in great part, with a long and admirable supplement on Euler and Fermat.

A year after his Diophantus, Heath published his "Apollonius of Perga" (1896), next year that on "Archimedes", and eleven years later (1908) his great three-volume edition of "Euclid". For "Archimedes" and for "Euclid" Heath had Heiberg's text to build on, save that the "Archimedes" lacked Heiberg's subsequent and very valuable discoveries. But with all due allowance for this, what great books these of Heath's are! No English editor had dealt with Apollonius since Halley two hundred years before, and even the received translations of Euclid were a hundred years old. To translate these books faithfully, and annotate them with all that had been most usefully written by Cantor, Bretschneider, Camerer and the rest, had been Heath's labour of love for years.

Heath had now dealt with Apollonius, Euclid and Archimedes, the three great "Greeks", who in Asia, Egypt and Sicily made the Golden Age of Greek mathematics; then he set to work to end and crown his labours with "A History of Greek Mathematics". It is a book not only for the mathematician but also for every scholar, for mathematics is the greatest of all the legacies of Greece. Of that Golden Age, of the dim Pythagorean times before, and of the later Silver Age, with Diophantus, Pappus, Ptolemy and the rest, we find all or well-nigh all we want to know in Heath's orderly and copious book. It has, doubtless, the *défauts de ses qualités*. Heath has little of the critical taste and gift of brevity which make Allman's book look like a little gem, after fifty years; nor had he Heiberg's fathomless erudition, deep as his own was; nor does he show, or ever want to show, much imagination or speculative curiosity. Like so many other classical scholars he never seemed to care about what Egyptians or Babylonians *may* have known or done; but when at last these great secrets began to be explored Heath became deeply interested, and he reviewed Otto Neugebauer's "Vorgriechische Mathematik" for Nature with full insight and appreciation.

There are yet other works of Heath's, and not a few. After finishing his "Diophantus" and before settling down to the "History", he wrote a book on that 'Copernicus of Antiquity', Aristarchus of Samos, led on to do so (as he says) by H. H. Turner, his comrade both at Clifton and at Trinity. Half of the book deals with Aristarchus; the other half is a sketch of Greek astronomy, from the starry heavens of Homer and Hesiod down to Plato and Eudoxus, then on more briefly to Hipparchus and Ptolemy.

I think that Heath was at his best when he dealt, encyclopædically, with the life and work of individual men. As a historian he was more sober than a man need always be; he lacked colour, and was afraid of imagination. He found even Paul Tannery "prone to run away with an idea", and *ex abundante cautela* is a tag I have heard him use and recommend. He might have told stories, even about I.47, which would have helped to lighten the three volumes of his "Euclid". But this was not Heath's way. He was a quiet, patient scholar, rejoicing in the things which mattered to him, and which, after all, are the things which matter most to all lovers of learning. Not many years ago he brought out a pretty little volume containing the Greek text of Euclid's first book. The introduction and notes are interesting, but I find the short preface still more so, in which he talks of the "thrill of pleasure" with which he first cast eyes on the Greek text, in the days when he was young and when that text was extant only in old and rare editions. Now he has brought this and many another famous book within reach of us all; and in doing so he has left us an example of sixty years of unstinted and unwearied work, all done for the mere love of it.

D'Arcy Wentworth Thompson.

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[*] The Diophantine equations hark back, as Heath explains, to the *hau*, or *heap*-calculus, of the Egyptians, and I suggested long ago that the Diophantine σ, answering to our x, might stand for *σωρός*, a *heap*. But Heath saw reasons to the contrary.

Sir Patrick Laidlaw, F.R.S.

SIR PATRICK LAIDLAW died on March 19 in his fifty-ninth year. His death is a major loss to medical science and a most grievous blow to all those who were privileged to know him personally.

Patrick Playfair Laidlaw, the son of Dr. R. Laidlaw, who was medical officer in the Seychelles, was born on September 26, 1881. A family removal to Cambridge enabled him to enter the Leys School, and from school he proceeded to St. John's College with a scholarship. He completed his medical course at Guy's Hospital and graduated B.Ch.(Camb.) in 1907.

Whilst still a student at Cambridge, Laidlaw gave evidence of his remarkable gifts for research by the publication of several papers on anatomical subjects and one outstanding piece of work on blood pigments. After a few years as demonstrator of physiology at Guy's, he joined the staff of the Wellcome Physiological Research Laboratories, and there, during the next five years (1909–14), he published, either alone or with his colleagues, more than a score of papers on pharmacological subjects, the best known of which is the classical work on histamine, carried out in collaboration with H. H. Dale. This happy and fruitful association with Dale was temporarily broken in 1914 when Laidlaw returned to Guy's as lecturer in pathology, but was renewed in 1922 when he was invited to rejoin the staff of the National Institute for Medical Research. Although never very happy in his academic teaching posts, Laidlaw's strenuous war years at Guy's had helped to give him the remarkable depth and width of knowledge in several medical sciences, which rapidly bore fruit in the new environment. He collaborated in important protozoological and biochemical investigations, but it is for his pioneer researches on virus diseases that he will be most especially remembered.

Laidlaw's study of canine distemper in collaboration with G. W. Dunkin will long remain a model for those engaged in virus research. In a series of papers they described the pathology of the disease in dogs and ferrets, brought forward irrefutable proof that the disease agent concerned is a filterable virus, and finally reported the successful immunization of dogs and ferrets by means of formolized virus vaccines. The outstanding importance of this work was immediately recognized and their method of prophylaxis adopted in veterinary practice.

His next major research was on influenza. Together with C. H. Andrewes and Wilson Smith he succeeded, in 1933, in isolating a virus from patients. This discovery provided a new basis from which to attack the many problems presented by epidemic influenza, and Laidlaw with his colleagues spent the next three years in laying the foundations of our newer knowledge of the disease. On his appointment as deputy director of the National Institute in 1936, he took a less active share in the influenza work but remained always at the service of those who carried it forward. On the outbreak of the War he turned with fresh enthusiasm to new virus problems, and continued working at them until the day of his death.

Laidlaw's work brought well-deserved recognition in his later years. He was elected a fellow of the Royal Society in 1927, was awarded its Royal Medal in 1933, and was elected F.R.C.P. in 1934. The following year he was honoured with knighthood. Shortly before his death he became an honorary fellow of his old college, St. John's, Cambridge.

It is not, however, as a famous man that Laidlaw will be mourned by those who knew him well, but as a wise and ever-helpful colleague, a generous and most loyal friend. Of a shy and reserved disposition, he shunned the limelight and detested anything which savoured of self-advertisement. His keen critical faculty was at the service of those who sought his advice, but was most constantly directed against himself and his own work. His curiosity had no bounds and urged him to incessant probings in new directions, so that his 'unsuccessful' experiments were a constant stimulus and source of inspiration to those around him. Well might he have said with Leeuwenhoek, "The work which I've done for many a long year was not pursued in order to gain the praise I now enjoy but chiefly from a craving after knowledge." W. S.

Prof. E. Branly

PROF. EDOUARD BRANLY, the inventor of the coherer, which enabled Marconi to develop wireless communication and who is known in France as the 'father of wireless', died on March 25 at the age of ninety-five. He was born at Amiens on October 23, 1844, and after showing great brilliance as a schoolboy entered the École Normale. In 1868 he became a professor at the Lycée of Bourges.

Branly's bent, however, was for research work. He therefore went to the Sorbonne and took up work in the physical laboratory and began his study of electricity and magnetism. He was a poor man, and in order to become self-supporting he qualified as a medical man and practised medicine for about twenty years, spending all his spare time in electromagnetic research, for which he received the degree of doctor of science. In 1873 he went to the Institut Catholique in Paris, where he set up a small laboratory, and it was here that his investigations led to the discovery that the electrical resistance between loose particles of metal, such as iron filings in contact with one another, diminishes under the influence of electric action.

In 1872, Branly published a paper on the "Measurement of the Intensity of Currents by the Electrometer"; in 1892, one on "The Electrical Resistance at the Contact of Two Metals", and in 1893 one on "The Property of Discharging Electrified Bodies Produced in Gases by Incandescent Bodies and by Electric Sparks" and in the same year, one on the "Resistance of Thin Metallic Films". The last four of these papers were published in abstract in the *Journal of the Institution of Electrical Engineers*.

Branly made a series of observations into the variations of conductivity of a large number of materials under varying electrical influences. He found that substances which responded best to the phenomenon of sudden increase of conductivity were iron, copper, brass, aluminium, zinc and similar metals. He discovered also that the conductive effect on metallic filings, caused by a nearby electrical discharge, persists for a comparatively long period, but disappears rapidly if subjected to a shock. He obtained the required result by tapping the tube in which the filings are contained. In this way he discovered a principle which was adopted in the original Marconi system. Marconi was very grateful for the help he had received from Branly. He acknowledged this help in his first cross-Channel marconigram in 1899, which was addressed to Branly. It read as follows: "Marconi sends M. Branly his respectful compliments across the Channel this fine achievement being partly due to the remarkable researches of M. Branly."

In 1889 Lodge showed that if two small metal spheres were arranged so that they were nearly touching and separated only by a very minute film of air, the current from a small battery was unable to pass between them. This was proved by the fact that no reading was observable when a sensitive galvanometer was placed in a circuit between them. When, however, a Leyden jar was suddenly discharged in their vicinity, the air film was broken down and they cohered, making electrical contact with one another and allowing a current to pass through the galvanometer. This experiment was described in the year 1890 before the Institution of Electrical Engineers and an account of it appears in the *Journal*. In 1890, Prof. Branly proved the very important fact that filings could be made to cohere by an electric discharge taking place in their vicinity. He described his researches in "La Lumière Électrique" (May and June 1891), and he showed that metal filings could be decohered by a slight concussion. Lodge realized the importance of this fact. He introduced modifications in the Branly coherer and improved its sensitiveness considerably.

Lodge exhibited his apparatus in 1894 before the British Association at Oxford, and received signals at a distance of 150 yards. At the time, the idea did not occur to him that this instrument might be turned to practical use for long-distance radiotelegraphy. In 1902 Branly made another coherer in the form of a tiny tripod, having steel points at the end of each leg. He stood this upon the surface of a flat plate of steel. Under normal conditions no current passed between the tripod and the plate, but in the presence of the Hertzian wave coherence took place. He arranged his recording apparatus in such a way as to jar the plate immediately the wave had passed, thus effecting decoherence.

Throughout the rest of his long life, Branly went steadily on with research work on wireless waves and made a number of discoveries which he communicated at various times to French scientific bodies. He also wrote a number of papers which appeared in the *Comptes rendus* of the Paris Academy of Sciences. Even after the outbreak of War he remained at work in Paris, but in October, yielding to the persuasion of his family, he returned to the country. He was made a Grand Officer of the Legion of Honour and received many foreign distinctions.

Dr. A. G. Jacques

In the field of experimental cell and general physiology the name of Alfred George Jacques had become increasingly prominent during recent years. *Science* announces that Jacques died by drowning on February 20, 1939—and to many readers of NATURE this news, already a year old, must come with the shock of surprise and it will occasion widespread regret among experimental biologists.

Though A. G. Jacques was born in England at Sutton, Surrey, on April 18, 1896, he was educated mainly in Canada, later obtained the Ph.D. degree at Harvard, and his name rightfully attained prominence from his work at the Rockefeller Institute for Medical Research. In fruitful collaboration with Dr. W. J. V. Osterhout, Jacques' early work was devoted to problems of cell physiology, using the large vesicles of Valonia and Halicystis as experimental material. These fascinating organisms still claimed his attention until his death which, it is learned, occurred at Bermuda, where he had conducted much of his experimental work. Theoretical and experimental works mainly published under his name, in the *Journal of General Physiology*, present an impressive record of a career so prematurely ended.

Jacques investigated the mechanism which regulates the composition of the sap of the large vesicles which he studied—he accepted the challenge which the outstanding accumulation of inorganic salts in plant cells presents—and his name will be identified with theories of salt absorption based on the view that salts enter cells in the form of undissociated molecules. This view arose from an ingenious series of experiments, in which Jacques collaborated, which showed that certain weak electrolytes (H_2CO_3, H_2S, NH_4OH, etc.) penetrate most readily as neutral molecules, and, therefore, their entrance into the sap was controlled by the pH relations of sap and external solution. This novel idea was extended by Jacques in his later work to embrace the entrance of the alkali metals into cells. A steady stream of papers, both theoretical and experimental, appeared under his name. It would be idle in short space to summarize his work; neither should we declare that he had reached his final goal; but the distance he had travelled in a few years of active work is the measure of the loss which science sustains by his untimely death. The challenge of the problem to which Jacques devoted himself still remains—those who take it up where he perforce relinquished it will long recognize his worth and regret his passing.

F. C. STEWARD.

WE regret to announce the following deaths:

Sir James MacKenna, C.I.E., formerly agricultural adviser to the Central Government of India, and director of the Agricultural Research Institute, Pusa, on April 3, aged sixty-seven years.

Dr. Oran Raber, plant physiologist and conservationist to the U.S. Forest Service, on February 29, aged forty-seven years.

NEWS AND VIEWS

Scandinavia

AUSTRIA, Czechoslovakia, Poland, Finland, and now Denmark and Norway have been attacked in turn by the reactionary forces of Europe. By sheer weight of numbers and over-powering military forces the totalitarian war machine is proceeding on its way, leaving as it passes a trail of physical and spiritual destruction. The University of Copenhagen includes the world-famous Institute of Physics presided over by Prof. Niels Bohr, For.Mem.R.S., whose genius has been responsible for much of our present knowledge of atomic physics. A letter from his Institute appears elsewhere in this issue. Prof. G. Hevesy, For.Mem.R.S., has worked there for the past few years. Prof. August Krogh, For.Mem.R.S., also of the University of Copenhagen, has an international reputation for his studies in animal physiology, and Prof. Boysen Jensen is equally well known for his work on plant physiology. There is also the famous Carlsberg Institute, whence much fundamental work on biochemistry has come. The name of Prof. Th. Mortensen, the distinguished zoologist and oceanographer, will also be associated with the Carlsberg Institute. Prof. N. E. Nørlund, For.Mem.R.S., director of the Danish Geodetic Institute, is known to mathematicians, astronomers and geodesists.

Norway has an active University at Oslo. Meteorological investigations initiated by Prof. V. F. K. Bjerknes, For.Mem.R.S., are the basis of modern weather forecasting. Prof. J. Hjort, For.Mem.R.S., is well known as a marine biologist; Prof. C. Størmer's work on the aurora will be familiar to many readers of NATURE. Prof. L. Vegard is a well-known astrophysicist on its staff; a letter signed by him also appears in our pages this week. The publications of the Bergen Museum are widely known. It is worth remarking that the names mentioned above include no fewer than six foreign members of the Royal Society. It cannot be expected in present circumstances that scientific work will proceed in these and other institutions in Denmark and Norway. Whether they take an active or a passive part in the present struggle, the peoples of these two countries will have the support of all who believe in the fundamental principles of academic and individual freedom.

Dr. S. Zuckerman

IN April 1939 Dr. S. Zuckerman was appointed to the chair of anatomy in the University of Birmingham, and plans were immediately discussed for the establishment in the Department of Anatomy of an experimental unit in order to allow the new professor to continue and develop the programme of work on which he has been engaged for some years. Unfortunately, the War has interrupted these discussions, and the plans have necessarily been shelved for the moment. In view of this, and also because Dr. Zuckerman is engaged in war work elsewhere, he has had to postpone the assumption of his appointment at Birmingham until more propitious times. Meanwhile Dr. C. F. V. Smout is the acting head of the Department of Anatomy at Birmingham. Dr. Zuckerman entered on his academic career as a medical student of the University of Cape Town. After spending two years there as a demonstrator of anatomy he came to London as a Union Research Fellow, and qualified in medicine from University College in 1928. During 1928–32 he was research anatomist of the Zoological Society of London. During 1933–34 he worked in the United States, first as a research associate in the Primate Laboratories at Yale and afterwards as a Rockefeller Fellow. On his return to England he joined Prof. Le Gros Clark at the University of Oxford as a Beit Fellow and Departmental demonstrator. Later he was appointed University demonstrator and Nuffield research worker in endocrinology, and he continues to hold these appointments for the present. While at Oxford Dr. Zuckerman has played an important part in the development of research laboratories of a modern type in the Department of Human Anatomy.

Dr. Zuckerman's first work was concerned with the processes of development and growth in monkeys and apes, and with the mechanisms underlying the social behaviour of these animals. Many of his early researches were incorporated in his books "The Social Life of Monkeys and Apes" and "The Functional Affinities of Man, Monkeys and Apes". These behavioural studies led him on to an inquiry into the reproductive mechanisms of primates—particularly the menstrual cycle and its control by hormonal and neural factors. This again, from observations on the relation of changes in water metabolism to the menstrual cycle, has turned his attention more recently to the problem of the interrelation of the adrenal glands and the gonads. Dr. Zuckerman has also published a number of papers dealing with the prostate gland and other male accessory reproductive organs, as well as the histogenesis of tissues which are sensitive to œstrogenic stimulation.

Gold Medallist of the Society of Antiquaries

THE Gold Medal of the Society of Antiquaries of London, which is regarded by archæologists as the highest mark of recognition of distinguished service to their science, has been awarded for the year 1940 to Aarne Michel Tallgren, professor of the archæology of Finland and the North in the University of Helsinki, for his studies in the prehistory of the Eurasiatic continent, with more especial reference to the development of culture in the northern regions of that tract. For more than thirty years his studies have been devoted to the elucidation of the broader problems of this field, upon which he has brought to bear a vast knowledge of detail combined with unfailing judgment and soundness of inference.

Since the close of the War of 1914–18, Prof. Tallgren's publications dealing with the archæology and cultural history of Finland and adjacent regions of the northern tract have brought him an outstanding reputation as an international authority on the study of European prehistory. An even greater service to archæological studies has been rendered by his periodical publication, *Eurasia Septentrionalis Antiqua*, which he founded in 1926 and edited, contributing liberally to the contents himself until, in 1939, the action of the Soviet Government, by cutting his line of communications with Russia, deprived him of the material essential to the continuation of his studies and constrained him to stop publication (see NATURE, 144, 971 ; 1939). This action of the Soviet followed Prof. Tallgren's account of conditions in Russia in his "Archæological Studies in Russia" (1936).

Epidemiology of Evacuation

IN his presidential address to the Section of Epidemiology and State Medicine of the Royal Society of Medicine on April 5, Dr. J. A. Glover, chief medical officer of the Board of Education, stated that in the evacuation carried out in Britain last autumn there were moved 1,270,000 persons, made up as follows : 734,883 school children, nearly all moved in the first two days before the beginning of war ; (2) some 260,300 young children accompanied by (3) some 166,200 mothers and other adults ; and (4) 12,291 expectant mothers. All these persons were moved with punctuality and precision without a single casualty in four days. As regards the incidence of infectious disease, the record of the first four months was extraordinarily good. The cases of diphtheria and scarlet fever notified were only two thirds of those which occurred in the corresponding period of 1938, and the cases of poliomyelitis were only one third, although all these three diseases had their seasonal maxima in autumn and were diseases to which school children were particularly liable. There was a decline in notifications of puerperal pyrexia.

There had been small epidemics of enteric fever before evacuation took place, but notifications afterwards fell, and in November and December were well below those of 1938. The expected epidemic of measles was not realized and particularly avoided the big cities, and especially London. The health record of evacuated special schools was very good. The comparative freedom from infectious disease was attributable to the careful preparations of the Ministry of Health, the good work of the medical and nursing services, the care of the foster parents and teachers, the general soundness of the environmental hygiene, and the splendid weather of the early autumn. Dr. Glover maintained that the general policy of dispersal in billets was preferable to that of concentration in camps, in view of the much greater risk of spread of disease in such concentrations of children. In conclusion, he stated that the evacuated child who remained in the reception areas benefited greatly in health.

National Union of Students: London Medical Committee

THE London Medical Students' Committee of the National Union of Students was formed shortly after the War began. The first important action which the committee took was to get the status of medical students defined by the Ministry of Health. Up to this time hospital authorities and the Ministry of Health both disclaimed responsibility. The position is now clearly that medical students have no obligations to the Ministry, and vice versa. A request was received recently from one of the northern universities that the London Committee should organize a conference on medical student life and work. The Committee is accordingly arranging a meeting to discuss the teaching of medicine and the methods of study, which, it is hoped, will be held in a Midland university in May. The conference will be divided into three main sections. The first part will be devoted to the pre-clinical student, the second to the clinical student, and the third to the newly qualified doctor.

There has been much discussion in the Press recently on reforms in medical education. Efficient teaching is no less necessary now than it was before the War ; in fact, with the prospect of courses being shortened, efficient teaching becomes even more necessary. The conference will therefore have two sessions on education in all its phases, and from the experience of delegates endeavour to formulate an improved scheme of medical teaching. This will be combined with an endeavour to assure to the newly qualified medical man adequate house appointments to make him fit to carry out his duties. Medical students have suffered as much as others from many recent hasty decisions, and the prompt response to attempts to cut out subjects (for example, pathology from the Conjoint Board Examination) from the curriculum has shown a very healthy feeling on the part of students that standards must not be lowered, and was perhaps instrumental in maintaining the standard of the curriculum. The medical practitioner has certain duties to the public, and therefore his qualifications must be such as to enable him to carry out these duties, whether in war-time or in the time of peace.

Pharmacopœia Revision

DR. C. H. HAMPSHIRE, secretary of the Pharmacopœia Commission, gave an account of the work which is being done in preparation for a new "British Pharmacopœia" in a lecture delivered at an evening meeting of the Pharmaceutical Society on April 9. He confirmed that the Commission hopes to provide standards not only for crude drugs and chemicals but also for as many galenical preparations and compounded drugs as possible, adding that it is essential that standards for such substances should have due regard to the possible loss of active matter during manufacture and subsequent storage. The greater part of the lecture was devoted to an exposition of recommendations made by various committees for the inclusion of new substances in the next "Pharmacopœia". Dr. Hampshire exhibited specimens of these substances, classifying them in their appropriate groups. With regard to vitamins, he said the principal preparations of this group recommended for description are: Standardized concentrated solutions of vitamins A and D; a vitaminized oil standardized to contain vitamins A and D in the proportion contained in a good average specimen of cod liver oil; halibut liver oil containing not less than 30,000 units of vitamin A per gram; and pure crystalline aneurine hydrochloride to replace the adsorbate of vitamin B_1, described in the "Addendum, 1936".

Dr. Hampshire explained the reasons for some of the proposed additions to the "Pharmacopœia". Thus mandelic acid and calcium mandelate are both in use in the treatment of urinary infections; sulphanilamide is recommended as the best known member of the sulphonamide group which is free from patent complications; parachlorometacresol is recommended for use as a bactericide in sterilizing solutions for injection, and as a bacteriostatic preservative in certain solutions. He said that the proposed inclusion of the sera and other biologically tested preparations is necessary in order to bring this section of the work of the "Pharmacopœia" up to date. In this field the "Pharmacopœia" is kept closely in line with the regulations under the Therapeutic Substances Act; the regulations provide for the control of biologically tested substances in Great Britain and Northern Ireland, while the "Pharmacopœia" extends the control to other parts of the British Empire in which the "Pharmacopœia" is accepted as a legal standard. The revision has included a full review of all analytical procedure described in the various monographs and in the appendixes. In two directions a considerable increase in analytical methods is proposed: (*a*) the addition of new tests and assays for galenical preparations and compounded drugs; and (*b*) the addition, in a number of instances, of assays for the alkaloidal content of salts of various alkaloids.

Astronomical Investigations of Horrox

PROF. F. J. M. STRATTON has published a very interesting and full account of the work of Horrox (*Occas. Notes Roy. Astro. Soc.*, No. 7; 1939). To many astronomers, Horrox's fame rests almost entirely on his observation of the transit of Venus on November 24, 1639 (O.S.), his own calculations having shown an error in the Rudolphine tables, and also that a transit should take place on the above date. This was only a small part of his work, for, in addition to improving the tables then in existence, he was the first to show that the moon's orbit around the earth is an ellipse, the earth being at a focus. An excerpt from some of his writings at the age of eighteen shows that he anticipated Newton in connecting the movements of the planets with that of a body falling to the earth. The motion of the line of apses was explained by Horrox as due to the disturbing effect of the sun, and he was able to illustrate the idea by a simple pendulum experiment. In addition to his explanation of other difficulties connected with the motion of the moon, he detected the long inequalities in the opposite sense in the motions of Jupiter and Saturn, and he showed that comets move in elliptic orbits around the sun.

Although he undertook regular observations of the tides, no published work of Horrox on this subject survives, but he expressed the hope to Crabtree less than a month before his death that he would shortly detect the secret of the tides. Kepler's value of the distance of the sun was 3,500 times the earth's radius, and Horrox gave the value as 15,000, that is, about two thirds the correct value. It is amazing that Newton adopted 5,000 fifty years later, instead of using Horrox's 15,000. When it is remembered that these results were obtained by one who had only attained the age of twenty-one and that he was practically self-taught and unaided, it is not surprising that astronomers have kept his name in affectionate remembrance for hundreds of years. What fields would Horrox have explored if he had not died at the early age of twenty-two in 1641, the year before Newton was born? In 1874, when a transit of Venus occurred, a memorial was erected to him in Westminster Abbey, and over the monument are carved the words in which Horrox reported that he had abandoned the observations of the sun to carry out his spiritual duties in the Church.

King Psusennes's Tomb at Tanis

Now that the jewellery associated with the sarcophagus of King Psusennes at San el Hagar, in Lower Egypt, has been removed to the Cairo Museum, further details are becoming available which serve to indicate more fully the cultural and historical significance of the find. The similarity in the circumstances of discovery with those of the discovery of the tomb of Tutankhamen is striking. For years Lord Carnarvon and Howard Carter excavated in the Valley of the Kings without notable success until they made their great discovery. At Tanis, which had already been explored by both Mariette and Petrie with indifferent results, Prof. Montet pursued his investigation of the relics of the obscure Twenty-first and Twenty-second Dynasties for nine years from 1929, before last year he made the remarkable discovery of the gold and silver sarcophagus of King Shishak, of the Twenty-second Dynasty, in the otherwise rifled tomb of King Psusennes, of the Twenty-first Dynasty.

The tomb of Psusennes, son of Smendes, founder of the Twenty-first or Tanite Dynasty, is situated in the temple of Rameses. It is of solid rose granite, it is stated in a communication from the correspondent of *The Times* in the issue of April 6, and is a few metres underground. Entrance is at present down a shaft about four metres deep through rock and sand. A small anteroom leads by a short passage, about two metres long, and hewn through solid granite, into the funerary chamber. This is also small, measuring only seven metres long by about three metres wide and high. The sarcophagus itself is 3½ metres long, and not less than 2½ metres wide. An unusual feature of the outer sarcophagus is the decoration on both the upper and under surface of the cover. On the upper surface is a full length image of the king dressed as Osiris. Broken features of the image of the inner sarcophagus suggest that it was damaged when being introduced into the tomb.

Antiquity: a Sutton Hoo Number

Antiquity of March last is devoted to a detailed account of the discovery, excavation and finds of the Sutton Hoo ship-burial. The excavation is described by Mr. C. W. Phillips, who points out that until 1939 the archæology of Britain in Anglo-Saxon times has had to concern itself little with either ship-burials or to a great extent with rich burials of any kind, for omitting those of Kent, and a few important burials at Taplow, Broomfield and elsewhere, the most striking feature of Anglo-Saxon graves is their almost universal poverty. In the more detailed description of the finds Mr. T. D. Kendrick gives accounts of the gold ornaments, the large hanging bowl and the jewellery; the silver is described by Mr. Ernst Kitzinger, and a summary account of the coins is contributed by the editor, Mr. O. G. S. Crawford. Mr. W. F. Grimes is responsible for a description of the methods followed in salvaging the finds, "an exciting and exacting task, extending over more than a week", in which he was first called to participate when the gold purse and its trappings had been found. Serious problems were presented by corrosion, but their solution called for no new and elaborate technical methods, but rather the application of simple readily available means to deal with an unexpected range of materials, each apart from the gold objects with its own set of problems. The identity of the individual whom the mound and its contents commemorated is discussed in full detail by Dr. H. Munro Chadwick, who accepts the possibility that it may have been the cenotaph of a king lost at sea—the editor of *Antiquity* here points out that there never has been question of a burial. After discussion of the various possibilities Dr. Chadwick elects for Redwald (*ob. c.* 624–5) as the most probable. The series of photographs accompanying these contributions constitutes a valuable record of this notable find.

Indian Farming

THIS new monthly magazine, issued by the Imperial Council of Agricultural Research, replaces the bi-monthly *Agricultural and Livestock in India*, published by the Council since 1931. The aim of *Indian Farming* is to present scientific information in a popular form, and to form a link between the research worker and the cultivator. The format of the new journal is more pleasing than that of its predecessor and should appeal to a wider public. The contents include original articles on agricultural science, short notes on selected research work, reports from research stations, "answers to correspondents", practical hints to farmers, and book reviews. The popularization of agricultural science is a task as difficult as it is important, and the editorial committee is to be congratulated on its good beginning in seeking the happy mean between over- and under-simplification. The first article, by Sir Jagdish Prasad, on agricultural research in war, puts in a timely plea for the continuation of pure research during a period of stress when the demands for immediate results are most pressing.

Fluorescent Enamel Paints

THE Continental Lithograph Corporation, 952 East 72nd Street, Cleveland, Ohio, has put on the market a series of 'enamel paints' (Conti-Glo Fluorescent Lacquer Enamels) with which brilliant fluorescence effects can be obtained when they are illuminated by radiation in the 'near ultra-violet'. Such a radiation can be conveniently obtained from tungsten filament lamps having bulbs of 'black' glass; these are supplied by the same Company. They are mounted in aluminium reflectors in order to concentrate the ultra-violet energy on the enamelled surface.

Tested with a mercury vapour lamp screened by a plate of ultra-violet transmitting glass, the samples appear to justify the maker's claims. The colours include white, pink, and orange, with various yellows, greens, and blues. Moreover, the fluorescent hue is markedly different in some cases from that of the paint in ordinary light; thus a cream paint becomes a green in the ultra-violet and a rose colour fluoresces red, while a white becomes a blue. These enamels have interesting possibilities for entertainment and decoration. They are said to be easily applied by ordinary spraying and brushing methods, and can even be applied (diluted with lacquer-thinner) to fabrics.

Saliva Superstitions

THE December issue of *Folk-Lore* contains a richly documented article on this subject by Miss Rachel Sclare, of Leeds, who illustrates the medicinal and curative properties attributed to saliva throughout the ages and different parts of the world by quotations from the New Testament, the writers of classical antiquity (Theocritus, Tacitus and Pliny), the Middle Ages (Hildegarde of Bingen, Maimonides, and Albertus Magnus), and modern times (Brand, Tylor and Frazer). The diseases for which saliva has been used both as a curative and less frequently as a prophylactic measure are numerous, and include sore eyes, blindness, rheumatism, headache, toothache, warts, burns, wounds, etc. As a prophylactic, saliva has been employed as a protection against infectious diseases and as an antidote to poisons, as well as a means of averting ill-luck. The belief in the magical properties of saliva, which still flourishes not only in primitive races but even in England as well as in other civilized countries, appears to be founded on the supposition that this secretion possesses a vital force closely connected with man's blood and the whole of his person.

The Bed of Procrustes

A WITTY and amusing paper with this title was read by Mr. Gordon D. Knox before a meeting of the Tenterden Toc H (Tenterden: K. P. Press, 1940. 1*s*.).

It will be recalled that, in Greek legend, Procrustes made all travellers who visited him lie on a bed of fixed length, stretching their limbs if they were too short and lopping them off if they were too long. Mr. Knox suggested that this treatment, although murderous when applied to human beings, is beneficial when applied to problems. It is a great advantage to make a wide range of problems conform to one fixed type, namely, that usually known as the method of ratio or proportion. Examples were given of applications to arithmetic, algebra, geometry and applied mathematics.

Books on the History of Science and Medicine

CATALOGUE 55, recently issued by E. P. Goldschmidt and Co., 45 Old Bond Street, W.1, is devoted to bibliography and reference books, particularly those dealing with the history of science and medicine. Attention may be directed to the following items: A. Claudius's "Histoire de l'imprimerie en France" (1900–1914), Du Cange's "Glossarium mediæ et infimæ Latinitatis" (1883–1887), Thomas James's "Catalogue of the Bodleian Library" (1620–1635), J. S. Bailly's "Histoire de l'Astronomie ancienne—Histoire de l'Astronomie moderne—Traité de l'astronomie Indienne et Orientale" (1781–1787), L. Choulant's "Handbuch der Bücherkunde für die aeltere Medizin" (1828), John Ferguson's "Bibliographical Notes of Histories of Inventions and Books of Secrets" (1883–1916), John Leland's "Laboryouse Journey and Serche for Englandes Antiquitees" (1549), and Andrew Borde's "Fyrst Boke of the Introduction of Knowledge" (1548).

Aftershocks of the Great Turkish Earthquake

As anticipated by the seismologists at the Istanbul Observatory, aftershocks of the great Turkish earthquake of December 27 (NATURE, January 6, p. 13) still continue, and these have been accompanied by floods possibly due to changes of land-level occasioned by the shocks. The region most affected recently has been near the scene of the original disaster. On April 3, two violent earthquake shocks occurred in the region of Amasya in Anatolia. No casualties are reported. Following torrential rains, the Yesil Irmak and the Tersakar Dere burst their banks, flooding wide areas, including the famous apple orchards near Amasya, and also inundating about thirty villages, some of which have had to be abandoned. Twenty-five villages were cut off by the floods. No casualties have been reported.

Cerebro-Spinal Fever

CEREBRO-SPINAL fever, caused by infection with the meningococcus, was epidemic in Great Britain in 1931 and 1932, some 2,200 cases being notified in each year. The number of cases then declined, and in 1935 and 1936 the annual total was about 900. Since then there has been again a rise, to 1,500 cases in 1939. In the first seven weeks of this year there were 1,753 cases, and 623 new cases were notified in the week ending March 2. In view of the prevalence of this epidemic, the Ministry of Health has issued a "Memorandum on Cerebro-Spinal Fever" (Memo. 234/Med. H.M. Stationery Office. 2*d.* net). It discusses the epidemiology of the disease, the control of contacts (who may be carriers of the meningococcus) and diagnosis, and describes the treatment and general measures of prevention. Formerly, the administration of anti-meningococcal serum was the only specific treatment, and is still desirable in the very acute cases. Treatment has, however, now been revolutionized by the use of the drugs sulphapyridine and sulphanilamide, and full directions are given as regards dosage and method of administration.

Announcements

PROF. WALTER W. STEWART has been elected to succeed Mr. John D. Rockefeller, jun., who has retired from his position both as chairman and as member of the Board of the Rockefeller Foundation. Prof. Stewart, who is fifty-five, was during 1928–30 an economic adviser to the Bank of England. In 1931 he was appointed American member of the special advisory committee to the Bank for International Settlements. He is a professor of economics at the Institute for Advanced Study at Princeton University.

THE Ettore Marchiafava Prize, founded by the University of Rome on October 28, 1938, for the best work on morbid anatomy or general pathology, has been awarded to Profs. Mario Monacelli, director of the clinic for dermatology and syphilis at Messina, and Giulio Raffaele, of the University of Rome.

AT the recent annual general meeting of the Institute of Metals, held in London, the following officers were elected: *President*, Lieut.-Colonel the Hon. R. M. Preston; *Vice-Presidents*, Dr. S. F. Dorey, Engineer Vice-Admiral Sir George Preece and Mr. A. J. G. Smout; *Treasurer*, Lieut.-General Sir Ronald Charles; *New Members of Council*, Dr. W. E. Alkins, Mr. G. L. Bailey, Captain F. C. Braby, Colonel P. G. J. Gueterbock, and Prof. D. Hanson.

AN after-luncheon lecture will be given at the Chemical Club, 2 Whitehall Court, London, S.W.1, on April 15 by Mr. Arthur Elton, who has taken for his title "The Interpretation of Science by the Film". Mr. Elton is at present at work on the Government scheme, initiated by Sir Kenneth Clark, of propaganda films of a technical nature.

A CONGRESS of Forensic Medicine, Insurance and Criminal Anthropology will be held at Naples during May 30–June 1. Further information can be obtained from the general secretary, Prof. Gennaro Punzo, Via Luciano Armanni 3, Santa Patrizia.

ACCORDING to a census on June 30, 1939, the total aboriginal population of Australia was 77,269, including 25,712 half-castes. Nearly half the total full-blooded natives were in Western Australia. In New South Wales there were only 794.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 593. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Mass Centre in Relativity

THE question whether there exists in relativity mechanics a theorem analogous to the classical law for the motion of the mass centre (conservation of total momentum) has, as far as we can see, never found a satisfactory answer. Eddington[1] has taken this fact as the starting point for a general attack against the usual application of wave mechanics to fast-moving particles without contributing himself anything positive to the question. The reason why this problem has never been seriously treated seems to be this.

In classical mechanics the internal potential energy depends on the simultaneous relative positions of the particles; therefore one can separate the relative motion from the translatory motion of the centre. In relativity, however, all forces are retarded, the interaction does not depend on simultaneous relative positions and the separation of the relative motion from the translation of the whole system loses its meaning.

Quantum mechanics circumvents this problem by considering interactions as produced by emission and reabsorption of other particles. We were induced to reconsider this problem by its bearing on a relativistic and 'reciprocal' formulation of second quantization. Without touching this question, we shall state here some simple results concerning free particles. It is clear that in this case there must exist a 'rest system' Σ°, that is, a Lorentz frame in which the total momentum vanishes. The problem is to describe the relative motion in an invariant way.

We start by bringing the classical derivation into a form permitting generalization. If $\mathbf{r}_1$, $\mathbf{r}_2$ are the position vectors, $\mathbf{p}_1$, $\mathbf{p}_2$ the momenta of two particles, we form the vector of relative position and that of total momentum

$$\rho = \mathbf{r}_1 - \mathbf{r}_2, \quad \mathbf{P} = \mathbf{p}_1 + \mathbf{p}_2, \tag{1}$$

and determine their canonical conjugate variables' components of the vectors π and $\mathbf{R}$. A simple calculation shows that these are not uniquely determined but have the form

$$\pi = (1 - a)\,\mathbf{p}_1 - a\mathbf{p}_2, \quad \mathbf{R} = a\mathbf{r}_1 + (1 - a)\,\mathbf{r}_2, \tag{2}$$

where a is an arbitrary constant. Hence another condition must be added.

We postulate that the kinetic energy $p_1^2/2m_1 + p_2^2/2m_2$ assumes the form $P^2/2m + \pi^2/2\mu$. This condition leads to a determination of the three constants a, m, μ, namely,

$$a = \frac{m_1}{m_1 + m_2}, \quad m = m_1 + m_2, \quad \mu = \frac{m_1 m_2}{m_1 + m_2},$$

which introduced into (2) give the usual expressions for relative momentum and centre of mass.

In relativity, the energies E_1, E_2 of two free particles are given by

$$E_1^2 = m_1^2 + \mathrm{p}_1^2, \quad E_2^2 = \mathrm{m}_2^2 + \mathrm{p}_2^2. \tag{3}$$

We consider now the 4-vectors $\mathbf{p}_+ = \mathbf{p}_1 + \mathbf{p}_2$, $E_+ = E_1 + E_2$ and $\mathbf{p}_- = \mathbf{p}_1 - \mathbf{p}_2$, $E_- = E_1 - E_2$. A simple calculation leads to

$$E_+^2 = m_+^2 + p_+^2 + \pi^2, \quad E_-^2 = m_-^2 + p_-^2 - \pi^2; \tag{4}$$

here $m_+ = m_1 + m_2$, $m_- = m_1 - m_2$

and
$$\pi = 2m_1 m_2 \sinh \Gamma/2, \tag{5}$$

where Γ is the 'angular distance' of the two 4-vectors, given by

$$m_1 m_2 \cosh \Gamma = E_1 E_2 - \mathbf{p}_1\mathbf{p}_2. \tag{6}$$

Γ is invariant, hence π is invariant also. π has a simple meaning in the case of equal masses. In the rest system Σ°, where $\mathring{P} = \mathring{p}_+ = \mathring{p}_1 + \mathring{p}_2 = 0$, we have $m_1 - m_2 = m_- = 0$, and $\mathring{E}_1 - \mathring{E}_2 = \mathring{E}_- = 0$; hence $\pi^2 = (\mathring{p}_-)^2$. This shows that π is the length of the vector $\boldsymbol{\pi}$ representing relative momentum.

For different masses $\boldsymbol{\pi}$ can be described as the relative momentum in that Lorentz frame (which always exists) in which

$$E_1 - E_2 = \pm\,(m_1 - m_2).$$

The first equation (4) can now be written

$$E^2 = M^2 + P^2, \quad M^2 = \mu^2 + \pi^2, \tag{7}$$

where $\mu = m_1 + m_2$ is the sum of the rest masses, M the total internal energy, which represents also the rest mass of the whole system, and $\mathbf{P} = \mathbf{p}_+ = \mathbf{p}_1 + \mathbf{p}_2$ the total momentum.

Taking the components of $\mathbf{P}$ and $\boldsymbol{\pi}$ as new canonical momenta, one can determine the conjugate co-ordinates, $\mathbf{R}$ and ρ. They are linear in $\mathbf{r}_1$, $\mathbf{r}_2$; the coefficients are, however, not constants but functions of $\mathbf{p}_1$, $\mathbf{p}_2$.

For small $\mathbf{p}_1$, $\mathbf{p}_2$ the formulæ reduce to the classical ones.

It is interesting to remark that in relativity there exists a 'reciprocal'[2] theorem obtained by interchanging co-ordinates and momenta.

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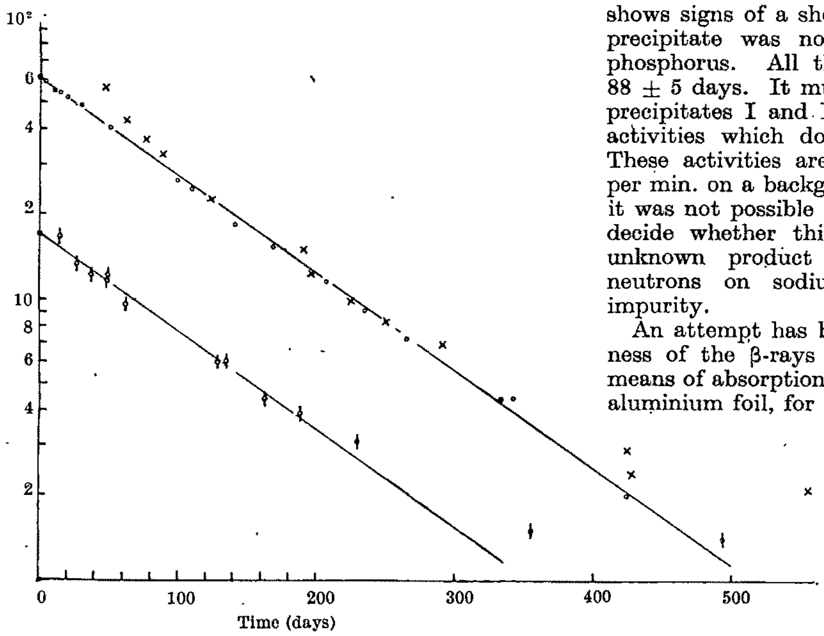
[1] Eddington, A., *Proc. Camb. Phil. Soc.*, **35**, 186 (1939).

[2] Born, M., *Proc. Roy. Soc. Edinburgh*, (ii), **59**, 219 (1939).

Radio-sulphur

A RADIOACTIVE isotope of sulphur produced by the action of neutrons on carbon tetrachloride and decaying with a period of 80 days was first observed by E. Buch-Andersen[1]. In view of the very weak activity found, doubt was expressed as to the existence of this isotope. This fact induced us to investigate the action of fast neutrons on carbon tetrachloride and sodium chloride. In both cases the radioactive sulphur was obtained; the use of sodium chloride was found, however, to be preferable. Recently[2], the $^{35}_{16}$S has been produced by the action of deuterons on sulphur, by making use of the Berkeley cyclotron.



DECAY CURVES FROM THREE BARIUM SULPHATE PRECIPITATES: ×, PRECIPITATE I; o, PRECIPITATE II; ϕ, PRECIPITATE III.

The neutron sources, consisting of 600 mgm. radium plus beryllium, were placed in the centre of a glass vessel containing 2 kgm. of pure sodium chloride. After the lapse of two months, the sodium chloride was dissolved in water, and 20 mgm. of inactive sodium sulphate was added. In order to oxidize the radioactive sulphur possibly present in elementary state, nitric acid and hydrogen peroxide were added, and the sodium kept boiling for several hours. 100 mgm. of sodium phosphate was added, and the phosphorus was precipitated as ammonium phosphomolybdate. This procedure was repeated several times until the precipitate showed no essential activity. Finally, the sulphur was precipitated in the usual way as barium sulphate.

The activity of barium sulphate precipitates was measured by means of a Geiger counter provided with an especially thin mica window with regard to the very soft β-radiation emitted from the $^{35}_{16}$S. The window was mounted on a concave cylindrical surface (radius 38 mm.) in order to make it possible to use an extremely thin mica foil as a window. It has been shown[3] that mica disks of 1·2 mgm./cm.^{2} and 1 cm. in diameter could stand evacuation of the counter only when mounted on such a concave surface. This mica window absorbs very little of the very soft β-radiation from sulphur.

The accompanying graph shows decay curves from three different barium sulphate precipitates obtained by the method described above; the decay was followed for more than 500 days. Precipitate I shows signs of a shorter period, indicating that this precipitate was not completely free from active phosphorus. All three curves show a half-life of 88 ± 5 days. It must, however, be mentioned that precipitates I and III seem to show weak residual activities which do not follow the 88-day decay. These activities are, however, so minute (1 count per min. on a background of 3 counts per min.) that it was not possible with the present arrangement to decide whether this weak activity is due to an unknown product obtained by the action of neutrons on sodium chloride or to traces of impurity.

An attempt has been made to estimate the hardness of the β-rays emitted by our preparation by means of absorption measurements. A 30 mgm./cm.^{2} aluminium foil, for example, reduced the activity to less than 10 per cent of its initial value. In the present arrangement, the β-rays from uranium were reduced to half their intensity by 125 mgm./cm.^{2} of aluminium. This enables us to estimate the upper limit of the β-rays from sulphur to be $1{\cdot}0$–$2{\cdot}0 \times 10^5$ ev., in agreement with Libby[4].

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[1] NATURE, 137, 457 (1936); *Z. phys. Chem.*, B, 32, 237 (1936).

[2] Voge, H. H., *J. Amer. Chem. Soc.*, 61, 1032 (1939); Tuck, J. L., *J. Chem. Soc.*, 1293 (1939).

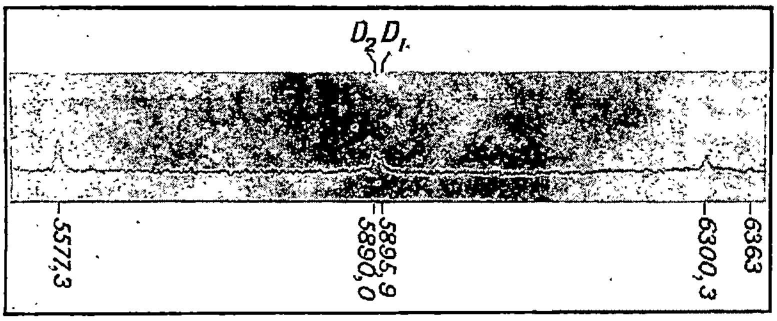
[3] Arnold, W., Frisch, O. R., and Levi, H., *Rev. Scient. Instr.*, 10, 197 (1939).

[4] Libby, W. F., and Lee, D. D., *Phys. Rev.*, 55, 245 (1939).

Origin of the Yellow Line in Twilight and the Night Sky Luminescence

THE appearance in the night sky spectrum of a yellow line was observed in 1929 by Slipher[1], who measured a wave-length 5892, by Dufay[2], Sommer[3], Cabannes[4] and by Vegard and Tönsberg[5]. The latter gave the wave-length 5892·6, and finding the line considerably broader than a single atomic line, they concluded that it had a fine structure. Twilight spectra giving the yellow line were obtained by Vegard at Oslo on January 13, 1936, and Tromsö in February of the same year[6].

Taking into account the time of exposure, the yellow line should be about 50–100 times stronger in twilight than in the night sky. In 1936 Currie and Edwards[7] published observations from the Polar Year programme showing the yellow line in twilight spectrograms. In November 1937 Bernard, working at the Tromsö Observatory, made further systematic investigations regarding the enhancement of the yellow line in the spectrum of twilight[8]. The wave-length found for the yellow line corresponds to the mean wave-length of the yellow doublet (D_1D_2) of sodium.



All the earlier wave-length measurements, which were based on spectrograms taken with very small dispersion (500–600 A./mm. at $\lambda = 5900$), were unreliable as a basis of interpretation.

An important step further was taken by Bernard[8], and at the same time and independently by Carbannes, Dufay and Gauzit[9], who analysed the fine structure with an interferometer and showed that the yellow twilight line had two components, the difference of wave-length of which was nearly equal to, or a single rational fraction of, that of the two components of the yellow sodium line.

These interferometer pictures, however, did not permit any wave-length determination, and until more accurate wave-length measurements were available, the origin of the yellow line could not be regarded as settled.

By means of a large glass spectrograph which at the yellow line has a dispersion of 99 A./mm., we obtained at Tromsö two spectrograms of twilight giving separation of the two components of the yellow line. The separation of the two components is shown in the accompanying reproduction of a microphotometer curve of one of the spectrograms, which also showed the green and red auroral O I-lines.

The D_1D_2 doublet of sodium was used as a comparison spectrum and *no difference between this doublet and that of twilight was observable in the comparator microscope. The two doublets also agreed with regard to relative intensity of the components.*

These results, together with the interferometer observations, show conclusively that the yellow twilight line is the D_1D_2 doublet of sodium.

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March 9.

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[1] Slipher, V. M., *Pub. Astro. Soc. Pac.*, 41, 263 (1929).

[2] Dufay, J., *C.R.*, **194**, 1897 (1932).

[3] Sommer, L. A., *Z. Phys.*, **77**, 374 (1935).

[4] Cabannes, J., *J. Phys.*, **5**, 601 (1934).

[5] Vegard, L., and Tönsberg, E., *Z. Phys.*, **88**, 709 (1934); **94**, 413 (1935).

[6] Vegard, L., and Tönsberg, E., *Geof. Publ.*, **11**, No. 16 (1937).

[7] Currie and Edwards, *Terr. Mag.*, **41**, 265 (1936).

[8] Bernard, R., *C.R.*, **206**, 448, 928 (1938); *Z. Phys.*, **110**, 291 (1938).

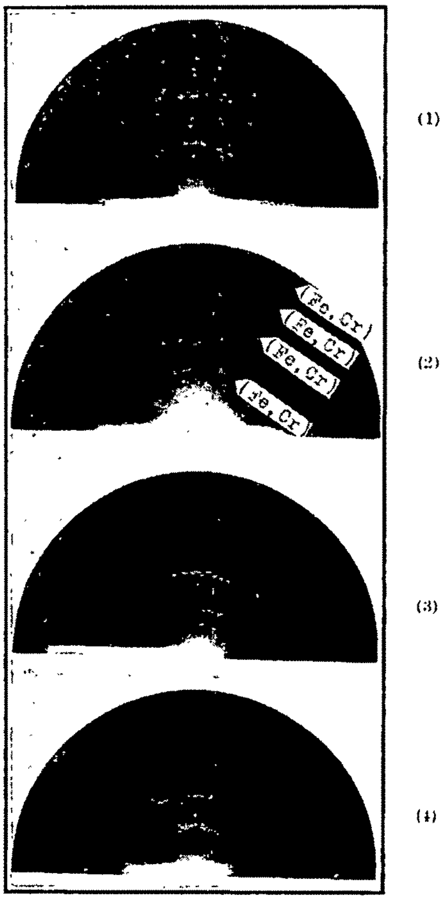
[9] Cabannes, J., Dufay, J., and Gauzit, J., *C.R.*, **206**, 1525 (1938); Nature, **141**, 1054 (1938).

Oxide Film on Stainless Steels

Electron diffraction methods have been used by Miyake[1] in studying the oxide film on a stainless steel (17 per cent chromium) at high temperatures (600–900° C.), and the substance was thought by him to be $FeCr_2O_4$ co-existing with Cr_2O_3 or with a solid solution of Cr_2O_3 and α-Fe_2O_3. Also G. P. Thomson[2] in his work on some reflection experiments states that "the naturally occurring film on stainless steel is possibly $FeCr_2O_4$ (cubic : a = 8·1 A.)".

The entire range in the iron-chromium system has been covered in the present study of the surface of these alloys at different temperatures. An example of the pattern given by an iron-chromium solid solution is shown in Fig. 1, which was obtained from a surface of an alloy containing 26 per cent chromium. Fig. 2, which was taken from the above specimen after heating for 200 hours at 200° C., already shows a pattern revealing the existence and identity of an oxide. When heated to 600° C., the oxide became crystalline within an hour (Fig. 3), clearly proving to be the α-Fe_2O_3 type (hexagonal). This α-Fe_2O_3 type was obtained with alloys of the entire iron-chromium system when heated at temperatures lower than about 600° C., and the oxide is without doubt α-$(Fe,Cr)_2O_3$.

At higher temperatures, however, the form of the oxide obtained is entirely different. The pattern which is shown in Fig. 4 (1000° C. for 15 minutes) is similar to that of the Fe_3O_4 type (cubic) and is



(1) Pattern (Fe, 26% Cr), (as polished). (2) Oxide recognizable (200° C., 200 hr.). (3) Oxide developed, α-$(Fe, Cr)_2O_3$ (600° C., 1 hr.). (4) Oxide transformed, $FeCr_2O_4$ (1,000° C., 15 min.).

the same as the one Miyake identified with $FeCr_2O_4$.

In interpreting the experimental results summarized above, it is natural to consider the oxide formed at lower temperatures as the naturally occurring film, which in the case of stainless steels has now been shown to be α–$(Fe,Cr)_2O_3$.

I wish to express my thanks to Dr. Iitaka for his guidance and encouragement.

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Feb. 5.

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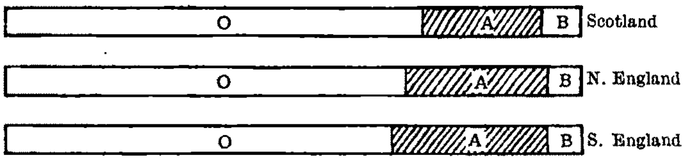
[1] Miyake, S., *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, 31, 161 (1937).

[2] Thomson, G. P., Unpublished observation cited by Thomson and Cochrane in "Theory and Practice of Electron Diffraction", 179 (London: Macmillan, 1939).

Scandinavian Influence in Scottish Ethnology

A FEW months ago[1] we appealed to centres of the emergency blood transfusion service, and in particular to those which we were supplying with testing serum, to allow us to assemble the extensive data on blood group frequencies in Great Britain, then for the first time becoming available. We were confident that such a collection would throw light on the precision with which such extensive groupings can be relied on to determine the gene-ratios in our population, and we hoped further that this precision might be sufficient to detect with certainty any such small variations of ethnographic significance as might exist within our island.

In a preliminary survey, exhibited at the meeting (January 12, 1940) of the Pathological Society at Cambridge, it was shown that a consistent gradient in the frequency of the antigen *A* is found as we pass from southern England to Scotland. Further data since accumulated bring our totals to 10,969 for Scotland and 8,716 for northern England, which show clearly intermediate frequencies. For southern England our compilation amounts to 106,477.



The values we present are not entirely unselected. A few returns have had to be set aside as apparently anomalous, and only in some cases has the cause of disturbance been ascertained. Systematic errors, not all of which are yet understood, do undoubtedly affect the frequency of the rarest of the four blood-groups (*AB*). As a further precaution, we have calculated the gene-ratios from the other three groups only, as in this way the effect of grouping errors is diminished.

The contrast between our three main areas, Scotland, England north of the Humber, and southern England, may be shown either in the relative frequencies of the four distinguishable phenotypes, or in those of the three allelomorphic genes :

TABLE 1

PHENOTYPIC FREQUENCIES

	O	*A*	*B*	*AB*
Scotland	52·019	34·233	10·429	3·318
N. England ..	48·600	40·340	8·536	2·524
S. England ..	45·232	43·162	8·508	3·097

The change in the ratio *A* : *O* is not, apparently, influenced by the traditional and political Border, but is apparently continuous, and doubtless a cause of heterogeneity, too slight to be detected on the numbers yet available, within the three chosen regions. The corresponding gene-frequencies are as follows :

TABLE 2

GENE FREQUENCIES

	O	*A*	*B*
Scotland ..	72·247	20·783	6·970
N. England ..	69·587	24·549	5·864
S. England ..	67·207	26·744	6·048

as shown in the diagram below.

It has been customary for ethnologists to suppose that the northern inhabitants of Britain differ from their southern neighbours by reason of a greater infiltration of Scandinavian blood. The modern Scandinavians, however, differ from the English in having not a lower but a higher frequency of *A*. Thus if, setting aside the small fraction of these populations carrying the gene *B*, we compare the phenotypic ratios $A/(A + O)$, we find, using the best available series, Norway 58·0, Sweden 58·6, Denmark 50·0, against S. England 48·8, N. England 45·4, Scotland 39·7.

English contact with neighbouring Europe has been extensive since the Roman period ; the values for Holland 48·6, Belgium 46·6, France 50·1, and Spain 53·4 are fully in accordance with the view that the English province has been influenced by settlement or intermixture with neighbouring Continental peoples. No Continental population, however, in the north or in the south, comes near to the Scottish ratio.

The only foreign sample we know of comparable to the new Scottish data is from Iceland. A sample of 800 in Wiener's collection gives the ratio $A/(A + O)$ as low as 36·6, slightly more extreme than the Scottish value. Now, Iceland was undoubtedly colonized from Norway, and, though men and women from Scotland and Ireland occur frequently in the Icelandic Sagas, it is not believed to have been extensively colonized from the British Isles. The stock from which the Icelanders sprang would seem to have just the blood-group constitution needed to harmonize with the gradient found in Great Britain, but in recognizing this stock as genuinely Scandinavian, we must distinguish it sharply from the modern Scandinavian peoples, which have evidently changed greatly, by infiltration from central or eastern Europe, since the Viking period. The Scottish and N. English blood-groups show, certainly not modern Scandinavian, but it may well be a proto-Scandinavian influence.

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[1] *Brit. Med. J.*, Oct. 21, 1939.

Kallikrein and Histamine

Kallikrein, Frey and Kraut's circulatory hormone, has been extensively studied from the pharmacological point of view by Frey, Kraut and Werle[1] and considered by Szakall[2] as the regulator of the capillaries and small vessels. This last condition would introduce some relationship between kallikrein and histamine. Recently, Ungar and Parrot[3] have shown that kallikrein produces secretion of gastric juice, and more recently Schneider and Springorum[4] have demonstrated the close similarity between the circulatory effects of kallikrein and histamine in the dog. All these facts have justified the inclusion of kallikrein among the histamine-like substances, although its physical and chemical properties exclude the idea of its being histamine itself.

To demonstrate the effects produced by kallikrein upon the small vessels of the rabbit skin we employed the trypan blue test. Kallikrein (= padutin) was injected intracutaneously in the adult rabbit and, five minutes after, a solution of trypan blue (1 per cent) was injected into the ear vein. A more and more extensive and beautiful blue spot appears in the locality of the intradermal injection. This positive reaction has been obtained by injection of irritant substances[5] and by a proper concentration of histamine[6]. Since the rabbit's skin is very rich in histamine, one might be induced to interpret this positive test as characteristic of a liberation of histamine. By assuming that kallikrein exerts its action by liberating histamine from the tissues, this would provide an explanation for its pharmacological properties.

Initially, a difficulty for this hypothesis would be the inactivity of kallikrein upon the isolated guinea pig gut. Moreover, we have verified that kallikrein inhibits the contracting action of histamine upon that organ; therefore, even if it liberated histamine from the smooth muscle, this last active substance would have its action inhibited by kallikrein itself. But in another way the hypothesis has been rendered very improbable by the fact that we have verified that kallikrein is also extremely active even upon the skin of very young rabbits (200 gm.), while histamine and a substance liberating histamine (turpentine) are not active or only very slightly so. Furthermore, in perfusion experiments with guinea pig lung kallikrein has been found devoid of any histamine liberating activity. Thus the pharmacological activity of kallikrein does not involve a liberation of histamine.

Indirect evidence has been put forward by Frey and Kraut[1] as well as by Szakall[2] for an increase of the capillary permeability after injection of large amounts of kallikrein. Since the seepage of the trypan blue into the intradermal injected area is very characteristic of an increase of capillary permeability, the experiment described above is a direct demonstration that kallikrein produces an abnormal filtration of colloidal matter through the walls of the capillaries.

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[1] Frey and Kraut, *Archiv. exp. Path. u. Pharm.*, **133**, 1 (1928); Werle, *Klin. Woch.*, **15**, 848 (1936); *Muench. Med. Woch.*, **11**, 407 (1937).

[2] Szakall, *Biochem. Z.*, **269**, 92 (1934).

[3] Ungar and Parrot, *C.R. Soc. Biol.*, **122**, 1052 (1936).

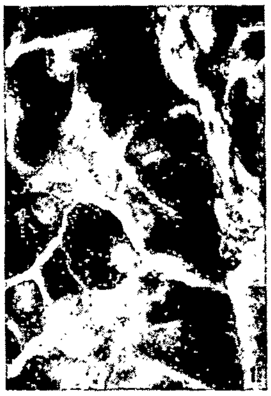
[4] Schneider and Springorum, *Z. klin. Chir.*, **194**, 373 (1939).

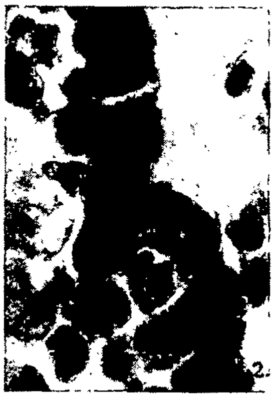
[5] Rocha e Silva and Bier, *Arq. Inst. Biol.*, **10**, 219 (1939).

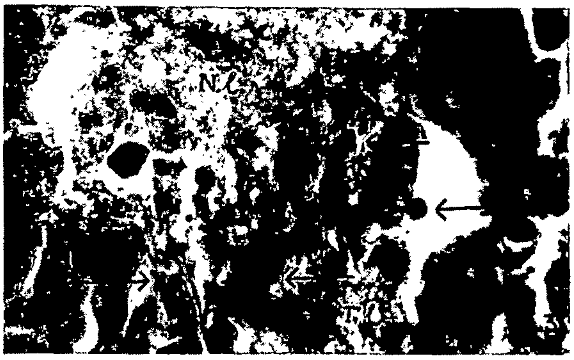
[6] Bier and Rocha e Silva, *Virchows Archiv.*, **303**, 325 (1939).

The Herring Material in the Perch Pituitary

In an investigation of the histology of the pituitary of the perch (*Perca fluviatilis*) a process of some general interest has come to light. Cells having the appearance of eosinophile leucocytes are present in the middle glandular or transitional lobe, and from them can be traced a succession of cells with fewer and larger inclusions to precise and brightly staining eosinophilic spheres which come ultimately to lie free among the cells of the lobe. In some series these spheres can be seen in all locations from the transitional to the nervous lobe, where they represent the larger elements of the Herring material in this form. Here in turn they appear to break down and form a characteristic granulation.







Photograph No. 1 (all photographs × about 1,000) shows two of these 'sphere cells' at an early stage among transitional lobe eosinophiles, No. 2 shows later stages, and No. 3 shows some spheres among the transitional lobe cells (*T. l*) and some in a process of the nervous lobe (*N. l*). No. 2 recalls certain cells noticed by Charipper[1] in the pituitary of Necturus, in which they appear to discharge directly into blood vessels. Herring[2] first described this material in the nervous lobe and looked upon it as probably secretion passing up to the third ventricle, but it has since been claimed to be simply unusual nerve endings in the lobe or an artefact due to precipitation. The sequence described here, however, including the demonstration of its origin, suggests that it is definitely secretory.

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March 11.

[1] Charipper, H. A., *Anat. Rec.*, **49**, 345 (1931).

[2] Herring, P. T., *Quart. J. Exper. Physiol.*, **1**, 121 and 261 (1908).

Inhibition of Respiration at Sub-optimum Substrate Concentrations

THE following note on respiration systems arose out of some calculations made for Mr. G. D. Greville in connexion with measurements of tissue respiration at the Middlesex Hospital, London. The case considered here is that with the substrate concentration less than the optimum and with carbon monoxide present as a respiratory inhibitor. The resulting equations are different from those originally obtained by Warburg[1], but, in correspondence, he has agreed with the present results.

We consider a homogeneous system respiring in a medium containing oxygen, carbon monoxide, and substrate.

In the absence of carbon monoxide, let A_s be the respiration with substrate concentration s, less than the optimum, and A the respiration with substrate concentration equal to or greater than the optimum.

In the presence of carbon monoxide, let A'_s and A' be the values corresponding to A_s and A. We now define

$$\varepsilon = A_s/A\,; \qquad \varepsilon' = A'_s/A'\,;$$
$$n_s = A'_s/A_s\,; \qquad n = A'/A\,;$$

so that

$$\varepsilon' n = \varepsilon n_s. \tag{1}$$

Let σ_{O_2}, σ_{CO}, and σ_s be those fractions of the catalyst which are combined with oxygen, carbon monoxide, and substrate respectively. When oxygen only is present, the respiration depends directly on σ_s, provided that the oxygen partial pressure is not less than a certain minimum value, which is always exceeded in practice, that is,

$$\sigma_s = \varepsilon. \tag{2}$$

When oxygen and carbon monoxide are present, residual respiration/inhibited respiration equals

$$n_s/(1 - n_s) = \sigma^s_{O_2}/\sigma^s_{CO}\,, \tag{3}$$

where $\sigma^s_{O_2}$ is that fraction of the whole catalyst which is in combination with oxygen and substrate simultaneously, and similarly for σ^s_{CO}. If the sum of the oxygen and carbon monoxide partial pressures is not less than a certain minimum value, then $\sigma_{O_2} + \sigma_{CO} = 1$, and this is the case in practice. We assume that the probability of finding an oxygen and a substrate molecule simultaneously in combination with a given catalyst molecule is equal to the product of the separate probabilities of finding oxygen or substrate molecules in combination with that same catalyst molecule, and similarly for carbon monoxide. That is, we assume that the distributions of both oxygen and carbon monoxide over the catalyst are independent of the distribution of substrate. Then

$$\sigma^s_{O_2} = \varepsilon\,\sigma_{O_2},$$

and similarly

$$\sigma^s_{CO} = \varepsilon\,\sigma_{CO}.$$

Therefore, from (3),

$$n_s/(1 - n_s) = \sigma_{O_2}/\sigma_{CO}. \tag{4}$$

Now, in the equilibrium state, rate of combination of oxygen with enzyme equals rate of dissociation of oxygen-enzyme complex plus rate of removal of oxygen by chemical reaction, that is,

$$\lambda_1 p_{O_2}(1 - \sigma_{O_2} - \sigma_{CO}) = \lambda_2\sigma_{O_2} + \lambda_3\sigma\,\sigma_{O_2}; \tag{5}$$

and similarly for carbon monoxide,

$$\mu_1 p_{CO}(1 - \sigma_{O_2} - \sigma_{CO}) = \mu_2\sigma_{CO}, \tag{6}$$

where p_{O_2} and p_{CO} are the pressures of oxygen and carbon monoxide in the solution, respectively, and λ_1, λ_2, λ_3, μ_1, μ_2 are constants.

Now, from equations (2), (4), (5), and (6), we have

$$\frac{n_s}{1 - n_s} = \frac{\sigma_{O_2}}{\sigma_{CO}} = \frac{p_{O_2}}{p_{CO}} \cdot \frac{a}{b + \varepsilon}. \tag{7}$$

where $a = \lambda_1\mu_2/\mu_1\lambda_3$ and $b = \lambda_2/\lambda_3$.

Also, from (1), we have

$$\frac{n_s}{1 - n_s} = \frac{\varepsilon' n}{\varepsilon - \varepsilon' n}. \tag{8}$$

It is evident from (7) that when the substrate concentration is diminished so that the system becomes unsaturated with respect to substrate, the respiration is less markedly depressed by carbon monoxide only when ε is not negligible in comparison with b. That is, when the rate of removal of oxygen by chemical reaction cannot be neglected in comparison with the rate of dissociation of oxygen-enzyme complex, or, in terms of the constants of the system, $\varepsilon\lambda_3$ is comparable in value with λ_2.

Publication of this result has been delayed many months because it was thought that an opportunity for verification might occur. As this has not been possible, the result is put forward in the hope that other workers in this field might be able to test it.

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March 8.

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[1] *Biochem. Z.*, 189, 354 (1927).

Photodynamic Hæmolysis by Carcinogenic Hydrocarbons

IN recent publications, Mottram and Doniach[1,2,3,4] reported that many carcinogenic hydrocarbons have a photodynamic effect upon Paramecia and upon the skin of mice. These hydrocarbons under the same experimental conditions did not cause photodynamic hæmolysis of erythrocytes.

This report deals with experiments made in order to find out whether by using a longer time of exposure, and a different technique of preparing the colloidal solutions of the three carcinogenic hydrocarbons, 3 : 4 benzpyrene, 1 : 2 : 5 : 6 dibenzanthracene, and methylcholanthrene, photodynamic hæmolysis could be obtained. (The carcinogens used were from the Union Chimique Belge 'Meurice'.)

The colloidal solutions of the hydrocarbons were prepared in the following way: 20 c.c. of isotonic saline solution were poured into a large Petri dish of approximately 30 cm. diameter. To this were added 10 c.c. of an acetone 1 : 10,000 hydrocarbon solution; the whole was left at room temperature, until all the acetone evaporated. The Petri dish was slightly shaken at the beginning in order to spread the solution all over the bottom. When the acetone had evaporated, the solution was poured into a test tube, care being taken to include all traces of hydrocarbon deposited on the wall of the Petri dish in the solution. This solution, which contains therefore a little less than 1 : 20,000 of hydrocarbon, was used throughout the experiment.

Red blood cells from sheep were washed three times in the ordinary way, and suspended in isotonic saline solution in the proportion of 1 : 100. The experiments were carried out in part by using a quartz mercury lamp (Hanau, type 'Jubiläums-Höhensonne', 220 volts, 3·8 amp.; distance 30–50 cm.), and in part in sunlight on bright days in February, March and April in Jerusalem. All the experiments were conducted in simple glass test tubes, of 8–9 mm. diameter.

Preliminary experiments in the dark, temperature measurements, and contemporaneous irradiation of control test tubes containing the suspension of red blood cells without the hydrocarbon, have eliminated the possibility of errors.

The results of our experiments may be summarized as follows:

(1) The colloidal solutions of 3 : 4 benzpyrene, 1 : 2 : 5 : 6 dibenzanthracene, and methylcholanthrene produced photodynamic hæmolysis.

(2) Under conditions in which we worked, in sunlight and with the above-mentioned dilution, the time required for complete hæmolysis was 1–1½ hours for 3 : 4 benzpyrene, 2½–3½ hours for 1 : 2 : 5 : 6 dibenzanthracene, and 1½–2 hours for methylcholanthrene.

(3) With the mercury-vapour lamp, the time required for complete hæmolysis for 3 : 4 benzpyrene and methylcholanthrene was 3 hours; with 1 : 2 : 5 : 6 dibenzanthracene hæmolysis was not complete after 4½ hours. The time required to obtain this hæmolysis by the hydrocarbons is much longer than the time required for them to produce a photodynamic lethal effect upon Paramecia—a fact which might have been foreseen from the results obtained by Mottram and Doniach. While Paramecia suspended in a 1 : 20,000 solution of 3 : 4 benzpyrene and irradiated by the quartz lamp under the above-mentioned conditions were killed in 5–7 minutes, the time required for complete hæmolysis under the same conditions was 3 hours.

Further studies which it is hoped will make it clear whether similar but non-carcinogenic hydrocarbons also possess photodynamic activity are being pursued. As yet, of four non-carcinogenic hydrocarbons tried, 1 : 4 diphenylanthracene, 9 : 10 diphenylanthracene, 1 : 4 : 9 : 10 tetraphenylanthracene and chrysene, not one has shown any photodynamic activity. (The non-carcinogenic hydrocarbons were kindly supplied to me by Dr. E. Bergmann, of the Daniel Sieff Research Institute, Rehovoth.)

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Feb. 1.

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[1] NATURE, 140, 588 (1937).
[2] NATURE, 140, 933 (1937).
[3] *Lancet*, 1, 1156 (1938).
[4] *Brit. J. Exp. Path.*, 20, 227 (1939).

Points from Foregoing Letters

M. Born presents a relativistic formulation of the theorem of the mass centre for free particles.

The radio isotope of sulphur, $^{35}_{16}$S, has been prepared by Hilde Levi from sodium chloride and from carbon tetrachloride. The sodium salt, which was found preferable for this purpose, was exposed for two months to neutrons from radium plus beryllium. Sulphur was precipitated as barium sulphate and was found to have a half-life of 88 days.

Using a large glass spectrograph of high dispersion, E. Tönsberg and L. Vegard have obtained spectrograms of twilight in which the two components of the yellow line are separated. This doublet appears, from the microphotometer curve, to be identical with the sodium doublet (D_1D_2).

T. Tokumitu finds that the two kinds of oxides formed on stainless steels are α–(Fe,Cr)$_2$O$_3$ at low temperatures and FeCr$_2$O$_4$ at high temperatures. His experimental results suggest that the naturally occurring film is the α–(Fe,Cr)$_2$O$_3$ form.

R. A. Fisher and G. L. Taylor state that new blood grouping data for England and Scotland show a decided gradient in the ratio $A : O$, antigen A being rarer in Scotland. This is the reverse of the effect of admixture with modern Scandinavians, who have more A than the English. Data from Iceland suggest, however, that Scandinavians of the Viking period conformed with the Scottish, and not with the modern Scandinavian, ratio.

M. Rocha e Silva presents strong evidence for an increase of the capillary permeability produced by kallikrein. The intradermal injection of kallikrein in the rabbit determines a seepage of trypan blue injected into the vein.

T. Kerr describes the origin of the Herring material in the perch pituitary from cells resembling eosinophile leucocytes found in the so-called transitional lobe. The granules of these cells become fewer and larger to form globules of various sizes which are set free in the tissue and find their way into the nervous lobe to form the larger elements of the Herring material. Here in turn they break down to become a fine granulation.

Warburg's treatment of the inhibition of respiration by carbon monoxide at sub-optimum substrate concentrations is incorrect. W. F. Floyd puts forward a solution to the problem with which Warburg has agreed in correspondence, but which has not yet been tested experimentally. The proposed solution shows that the inhibition of respiration is markedly diminished by unsaturation with respect to substrate only when the rate of utilization of oxygen is not negligible in comparison with the rate of dissociation of oxygen-enzyme complex.

M. Wolman has obtained photodynamic hæmolysis by the three carcinogenic hydrocarbons, 3 : 4 benzpyrene, 1 : 2 : 5 : 6 dibenzanthracene, and methylcholanthrene. The four non-carcinogenic hydrocarbons, 1 : 4 diphenylanthracene, 9 : 10 diphenylanthracene, 1 : 4 : 9 : 10 tetraphenylanthracene and chrysene, did not produce any such effect.

RESEARCH ITEMS

Early Mayan Datings

A NEW series of publications of the National Geographic Society at Washington, D.C., is inaugurated by a study by M. W. Stirling, chief of the Bureau of American Ethnology, Smithsonian Institution, of a Mayan dating carved on a broken and re-used stela from Vera Cruz, Mexico ("An Initial Series from Tres Zapotes, Vera Cruz, Mexico", *Nat. Geog. Soc.: Contributed Technical Papers, Mexican Archæology Series*, 1, 1; 1940). This monument was discovered in the course of archæological explorations conducted by a joint expedition of the National Geographic Society and the Smithsonian Institution at Tres Zapotes, Tuxtlas, Vera Cruz. Of some fifty mounds in four groups, each group with a rectangular plaza as a central feature, the easternmost, *C*, includes the second largest mound of the entire series, *C*1. In front of its south base was found a stela set up behind a roughly circular flat stone altar. It was a transverse fragment, intentionally broken in the middle, of a monument carved by an earlier people than those who re-used it. Facing the altar was a 'tiger-face' mask panel in low relief, while across the middle of the back was the greater part of an initial series. The numerals are in a vertical column with bars and dots placed horizontally—a rare but not unknown arrangement. The inscription is imperfect, but as restored by fully supported argument, it affords a dating which coincides with pottery finds, not yet fully worked out, but apparently to be assigned to the Middle American ceramic horizons. Only four other Initial Series are known, in which the style, with the horizontal arrangement of dot and bar, resembles that of this stela *C*, which is also the earliest of a group representing the earliest dates known in the entire body of Mayan inscriptions, and the three earliest of which have been found outside the classic Maya region.

Technique in Prehistoric Trephining

T. WILSON PARRY describes in *Man* of March 1940 the presumable method employed in trephining two prehistoric British skulls. Of these, one was found at Maiden Castle, Dorchester, in 1937 in association with a neolithic beaker of type *B*, the second in 1938 by Stuart Piggott in an early bronze age burial on Crichel Down, Dorset. At the time these two operations were performed, a notable advance in technique had been made, since the removal of a roundel of bone was more difficult and arduous than the elimination of a piece of bone reduced to dust by scraping, the method followed hitherto. In both examples the roundel had been removed from the left parietal. The dimensions in the Maiden Castle (late neolithic) skull operation are: laterally 65 mm.; ant. post., 52 mm.; oblique bevel of bone, 5–8 mm.; vert. thickness of skull, 5–7 mm. The corresponding dimensions in the Crichel Down (early bronze) skull are: laterally 60 mm.; ant. post., 70 mm.; oblique bevel surface, 9–14 mm.; vertical thickness of skull, 5–14 mm. The Crichel Down skull is altogether thicker and heavier than that from Maiden Castle. A specimen from the Grotto of Casa da Moura at Peniche, Portugal, now in the Geological Section of the Lisbon Museum, showing a continuous curving furrow united at both ends, is regarded as the first stage of the removal of a roundel of bone, the operation being unfinished. This method has not hitherto been described, but experiment with a neolithic beaked implement of flint on a recent skull has demonstrated the efficacy of what is here termed "the push plough" method, in which a thin, shallow furrow is gradually deepened until the bone is perforated. In neither skull is there any reparation of bone, so that if the operation was performed on the living, neither recovered.

Epidemic Dropsy in India

THE annual report for 1938 of the All-India Institute of Hygiene and Public Health, Calcutta, summarizes the teaching and research work carried out during the year. A most interesting research has been conducted on the disease known as 'epidemic dropsy'. A critical survey of its epidemiology, with much experimental work, led to the conclusion that this disease is associated with the use of mustard oil containing some toxic constituent. Mustard oil is widely used by the inhabitants for culinary purposes, and it was found that while some samples of mustard oil are innocuous, others are associated with the occurrence of epidemic dropsy, and experimentally induce the lesions associated with the disease. Investigation showed that the non-toxic and toxic oils could be distinguished by certain chemical and physical tests. Further investigation suggested that the toxic mustard oils might derive their toxic properties from some poisonous seed resembling mustard seed and mixed with it. After examination of a number of specimens of mustard seed, the seeds of *Argemone mexicana* were suspected to be the source of the poisonous substance in mustard oil. This plant grows wild and plentifully in various parts of India and becomes mixed with the mustard seeds at the time of harvesting. It was found that a mixture of 6 per cent of the oil expressed from the Argemone seeds with non-toxic mustard oil satisfied the same chemical and other tests as the known toxic oil, and experimentally induced the same lesions as the latter. The nature of the toxic agent is still under investigation.

Carotenoids and the Metabolism of Reproduction

THE possibility that carotenoid pigments have important biochemical roles in sexuality and the processes involved in the metabolism of reproduction is emphasized by R. Emerson and D. L. Fox (*Proc. Roy. Soc.*, B, **128**, 275; 1940). In the life-cycle of certain species of the aquatic phycomycete Allomyces, an asexual or sporophytic generation bearing thin-walled, colourless zoosporangia and thick-walled, brown, resistant sporangia, alternates with a sexual or gametophytic generation bearing colourless female gametangia and orange male gametangia. The pigment in the brown resistant sporangia of the asexual phase belongs to the melanin class and contains no carotenoid material. The orange pigment found exclusively in the male cells of the sexual phase is present in oil droplets within the cytoplasm and is not found in the walls of the male gametangia, but is still apparent in the male gametes after their emergence from the gametangia. The female gametes, which are more than twice the size of the males, contain no trace of pigment. In the orange pigment of the male cells, γ-carotene was found in high concentrations with variable small amounts of β-carotene. The authors point out the accordance of these findings with the existing knowledge of the synthesis and selective storage of carotenoids or their derivatives in structures associated with reproduction in many cryptogams, higher plants and animals.

Induction of Polyploidy in Rabbit Ova

G. Pincus and C. H. Waddington (*J. Hered.*, 30, 515–518 ; 1940) have treated fertilized ova of rabbits *in vitro*, with ethyl alcohol, ether, colchicine or with supra-normal temperatures. These treatments gave a significant decrease in the cleavage rate, while cytological examination showed that fifteen out of forty eggs were tetraploid, most of the tetraploids being in the colchicine series. It is suggested that the inhibition of cleavage and the rate of chromosome division are differently affected so that sometimes tetraploid ova are formed. Tetraploid ova ordinarily fail to cleave, but the few that do cleave do so at a subnormal rate.

Interspecific Hybridization in Medicago Hybrids

THE diploid form of *M. falcata* ($2n = 16$) does not readily cross with *M. sativa* ($2n = 32$), but the more usual hybrids are between the tetraploid *M. falcata* and *M. sativa*. The resulting hybrids form a fertile polymorphic group. Analysis of these hybrids and of artificial hybrids made between diploid *M. falcata* and *M. sativa* are described by G. F. Ledingham (*Genetics*, 25, 1–15 ; 1940). A histological examination shows that in the cross *M. falcata* ♀ × *M. sativa* ♂, fertilization takes place and development continues for about a fortnight. In the reciprocal cross, fertilization occurs, but development usually ceases after two days. It is suggested that the rate of physiological activity and cell division of the endosperm embryo and maternal tissue is initiated by the chromosomes of the gametic nuclei.

Fruit Flies of Northern China

IN *Sinensia*, 9 (1938), Nos. 1–2, pp. 1–150, there is an extensive contribution on the Trypetidæ or fruit flies of North China by Y. Zia and Sicien H. Chen. The journal in question, it may be added, is issued by the National Institute of Zoology and Botany, Academica Sinica, Pehpeichang, China. The present study is based upon material collected during a period of twenty-five years. Altogether, thirty-six genera and one hundred and thirty-five species are dealt with in this monograph. It is noteworthy that two of the genera and sixty-two of the species are described as being new. Special mention is made of the occurrence of two species of the genus Rhagoletis, namely, *R. reducta* and *R. scutellata*, for the reason that members of this genus are well known to cause much damage to fruits in Europe and North America. Although the relation of the two species named to horticulture in North China is unknown, their presence is noteworthy and is regarded as a menace to fruit production. It is creditable that, notwithstanding the disturbed condition of affairs in so much of China, the progress of natural science has not been wholly dislocated.

Sand-Dwelling Copepods

A. G. NICHOLLS continues his studies on copepods living in sand (*J. Marine Biol. Assoc.*, 23 ; 1939). New species are described from the Firth of Clyde and also from the St. Lawrence River. Revised keys are given for the species of Leptopsyllus and Paramesochra, Leptopsyllus now being restricted to those forms which lack endopods on the second legs. The two genera have been for some time in a state of considerable confusion, and although the author follows Kunz (1938) in basing the distinction on the presence or absence of an endopod on the second leg, he is of the opinion that the separation is not a natural one but will suffice until a thorough revision of these and allied genera has been made. An interesting find from Fintray Bay, Isle of Cumbræ, is *Remanea arenicola* Klie, occurring in relatively coarse sand near low-water mark. This species is so far only known from Kiel Bay. Three new species of Leptopsyllus and four of Paramesochra are described.

Weather and Radial Growth of Trees

AT the recent meeting of the American Association, Charles J. Lyon reported data from a New England forest, where suitable trees in close proximity to a meteorological station were blown down in a hurricane in 1938, as the result of an examination of their radial increment in comparison with the meteorological records. White pine, Scotch pine and red oak showed significant correlation with the rainfall of the spring months; but Austrian pine, Norway spruce and European larch showed no consistent correlation with the precipitation records of any period. There was almost no agreement between growth-rates and temperatures, though all the coniferous trees gave significant correlations between growth-rate and the temperatures of March and April, *before* the growth starts. This is interpreted as an effect of water supply, since the temperature of the air determines the frost in the soil. When the frost remains late in the spring, the water from the melting snow and from the early spring rains runs off to the rivers ; but this water is added to the water supply of the trees if the frost leaves the soil early. On the whole, the native white pine tree is particularly sensitive to its water supply, and was the best indicator tree of those tested in this study. The width of its annual rings is a better index of growing conditions for crops and forests than the weather bureau records of rainfall and temperature for the year.

Water Culture of Apple Trees

TREES of many different species have from time to time been grown in nutrient solutions, and the method has been widely used in nutritional studies. H. L. Pearce (*J. Pom. and Hort. Sci.*, 17, 344 ; 1940) has recently used the method for comparing the course of absorption of nitrogen and potassium in dwarf and vigorous apple trees. One year old trees of Cox's Orange Pippin on Malling stocks IX and XII were grown in continuously aerated culture solutions for a complete season and the absorption of nutrients and water followed by analysis of the external solution. Growth records showed that the two rootstocks maintained their respective dwarfing and vigorous habits in these conditions, whilst the uniformity of the trees was greater than that obtained in soil. An unusual feature was the fact that the trees on *M* XII, which normally exhibit delayed blossoming compared to trees on *M* IX, bore blossom as freely as those on the dwarfing rootstock. The vigorous trees absorbed more water per unit leaf area throughout the season than the dwarf trees, though the latter absorbed more per unit increase in fresh weight. The course of nitrogen and potassium uptake was closely similar in the two kinds of tree. The absolute amounts absorbed were greater for the tree on *M* XII, but the ratios of total growth made to nutrients absorbed did not differ significantly. No relation could, therefore, be observed between nutrient absorption and vigour.

Soil Decomposition of Straw

A RECENT paper by T. S. Sadasivan (*Ann. Appl. Biol.*, 26, No. 3, 497–508 ; 1939) shows that wheat straw is decomposed in soil largely by the activities of *Fusarium culmorum* and Mucor spp. These fungi were found on six different soils, but they appeared to give place to Penicillium spp. in the later stages of decay, or when the straw was treated with sodium nitrate.

Geochemistry of Fluorine

THERE has been little information available about the amounts of fluorine present in rocks, the lack of data being due mainly to the difficulty, hitherto, of determining fluorine with accuracy. The Willard and Winter procedure (*Ind. Eng. Chem.*, 5, 7–10 ; 1933) now furnishes an easy and surprisingly accurate method of analysis. E. S. Shepherd has established (*Amer. J. Sci.*, 117, 128 ; 1940) that fluorine is not so insignificant a constituent of the earth's crust as had been supposed. It is evidently present in quantities as great as, and sometimes greater than, chlorine, and this raises a question to which there is at present no satisfactory answer. What becomes of all this fluorine on denudation ? The author hopes with continued work to be able to trace the vagaries of this elusive element. Meanwhile, it appears that plutonic rocks characteristically contain about 0·04 per cent. The lavas examined tend to have about 0·01, even where large amounts of fluorine are known to have been exhaled. Obsidian, however, has an average content of 0·07, rising exceptionally to twice this amount. In certain regions, notably the African rifts, there are strong local concentrations. In sedimentary rocks the average is 0·027, but ocean bottom samples have nearly twice as much. No correlation between fluorine and other elements has yet been detected, except a dubious one with potassium. A suggested relationship with phosphorus has not been confirmed.

Molecular Rotation in Organic Crystals

DIELECTRIC constant measurements have established the rotation of molecules in certain crystals, such as those of halogen hydracids and hydrogen sulphide, and also in some organic compounds, including certain polar derivatives of camphane, cyclohexane and ethane. A. H. White, W. S. Bishop, B. S. Biggs and S. O. Morgan (*J. Amer. Chem. Soc.*, 62, 8, 16 ; 1940) have extended this field by dielectric constant measurements with crystals of two derivatives of ethane, one of cyclopentane, five of cyclohexane, and thirteen of camphane in the non-aromatic class, and with a number of benzene derivatives (3,4,5-trichloro-*o*-xylene, trichloro-*m*-xylene, 3-nitro-4,5-dichloro-*o*-xylene, 5-nitro-3,4-dichloro-*o*-xylene, pentachloroethylbenzene, pentaethylacetophenone, pentamethylnitrobenzene and *o*-dinitrotetramethylbenzene). In the case of the non-aromatic compounds, the dielectric constant mostly rises abruptly at a transition to a value characteristic of polar liquids, as the temperature is increased. A relatively symmetrical gravimetric and volumetric distribution of atoms around the centre of gravity of the molecule facilitates its rotation in the crystal. In the aromatic compounds the dielectric constant of the solid behaves like that of the corresponding liquid and may be correlated with the dipole moment. The less symmetrical of the molecules cease rotating abruptly at transitions, while the more symmetrical exhibit reduced frequency of rotation but no transitions with falling temperature. The temperature at which the relaxation time reaches a given value depends (with one exception) on the number of chlorine atoms in the molecule in the symmetrical hexasubstituted methylchlorobenzenes.

Magnetic Spectrograph Coils

WHEN a beam of slow-speed electrons or ions is to be analysed by projecting it through a magnetic field, it is advisable to make the field in the vicinity of the trajectory as uniform as possible, and in many cases two equal coils placed coaxially at a distance apart equal to their radii have been used. With the same electric current in the same direction through the coils, the field in the median plane is uniform near the magnetic axis only. M. Ference, A. E. Shaw and R. J. Stephenson, of the University of Chicago, have shown (*Rev. Sci. Inst.*, February 1940) that it may be rendered uniform over the volume of a ring of radius up to a third of that of the coils by bringing the coils a little closer together. The theoretical proof of this is verified experimentally by balancing the field against that of a standard coil, using a small magnet and mirror to test the balance. With coils of 30·776 cm. radius, the field within a ring of mean radius 8 cm. is most uniform with the coils 28·890 cm. apart, and within a ring of 10 cm. with them 27·838 cm. apart. In the latter case the change of field from 9 to 11 cm., and from the median plane to parallel planes 1 cm. away, is only one part in 4,000.

Nebulæ and Star Clusters in the Southern Hemisphere

H. Shapley and J. S. Paraskevopoulos have given some interesting pictorial results of a study of thirty nebulæ and clusters photographed with the 60-inch reflector at the Boyden Station, Bloemfontein, of the Harvard College Observatory (*Proc. Nat. Acad. Sci.*, January 1940). Three quarters of the external galaxies (extra-galactic nebulæ) that are near enough for close classification are spiral in structure, and most of the spirals can be placed in a few common categories. The illustrations given include several instructive curiosities and abnormal forms. One of these shown is *NGC* 55 (exposure 2 hours), which with a major axis of nearly 33′ is probably exceeded in angular dimensions only by the Andromeda Nebula and Messier 33. Its linear dimensions may prove to be outstanding among the external galactic systems. South African plates for the detection of Cepheid variable stars, used as distance indicators, are accumulating. Another plate shows the well-known globular cluster, Omega Centauri (exposure time 1 hour), one of the most remarkable of star clusters. Its total absolute magnitude is comparable to that of the small external galaxies, such as the companions to the Andromeda Nebula.

SUGGESTIONS FOR NEW UNITS IN PHYSICS AND ENGINEERING

A COMMUNICATION received from the Bureau International des Poids et Mesures summarizes the conclusions reached at the meetings last summer of the Consultative Committees for Electricity, Photometry and Thermometry. These conclusions would, in the normal course, have been reported to the International Committee for Weights and Measures at its meetings which were to have been held last September.

The Consultative Committee for Electricity recorded three resolutions. The first contains a recommendation as to the relationships which should be accepted between the existing international units and the proposed new practical absolute units, namely:

1 mean international ohm = 1·000 5 ohm (abs.)
1 ,, ,, ampere = 0·999 9 amp. (abs.)
1 ,, ,, volt = 1·000 4 volt (abs.)

The second resolution contains a number of clauses defining the proposed new units and the procedure to be followed in establishing and maintaining suitable reference standards. The third relates simply to the desirability, in order to avoid confusion, of appending the qualification "international" (abbreviated to "int.") or "absolu" (abbreviated to "abs.") in all references to the two series of units during the period of transition.

The Consultative Committee for Photometry also passed three resolutions. The first of these suggested that, while the 'new candle' should be introduced in legislation as from January 1, 1940, its legal application should be deferred until January 1, 1941. The second records a recommendation that comparisons of lamps at the higher colour temperature of 2800° K. should be organized forthwith between the various national laboratories; and the third outlines the relationship between the old and new units and the procedure to be adopted for the establishment of the new standards necessary.

The Consultative Committee for Thermometry passed two resolutions. The first of these records that, in the opinion of the Committee, the most probable value of the melting point of ice on the Kelvin scale, according to experiments so far completed, should be taken as 273·15° ± 0·02°. The second recommends that the unit of 'heat' should be the quantity of heat equivalent to the 'Joule', or 10^7 ergs; that the calorie should be defined as 3600/860 joules, or 1/860 watt-hours; and that the terms kilogram-calorie, or 'large' calorie, should in future be replaced by "kilo-calorie"; these recommendations to be submitted for approval, before final adoption, to the International Union of Physics, the Commission of Physico-Chemical Constants, and the Steam Tables Conference. In addition, the Committee recommended certain minor modifications to the existing specifications of the International Temperature Scale.

It will be realized that the functions of the Consultative Committees are purely advisory, and that any decisions based thereon must be taken by the International Committee itself. The fact that, as a result of the War, this Committee was unable to meet as arranged, has left all these various resolutions unconfirmed. In particular, some uncertainty arises as to the precise position with regard to the introduction of the proposed new electric and photometric units, which the International Committee had previously decided should come into force on January 1, 1940. The Consultative Committees concerned both encountered difficulty with regard to implementing these previous decisions.

In a covering letter to the summary, the acting president and secretary of the International Committee suggest that in all the circumstances, since uniformity of international action is most desirable in such matters, the introduction of the new units should be deferred until such time as the Committee is able to issue a further pronouncement.

TYPE TESTS IN ENGINEERING

IN a paper in the *Beama Journal* of January W. A. Coates, c/o Metropolitan-Vickers Electrical Co., Ltd., discusses the significance and value of type tests in engineering. A type test is defined as a text made on one piece of material or apparatus, which is accepted as indicating the characteristics of another. Naturally, therefore, there is always an element of chance when interpreting and applying the results of such tests.

One of the oldest examples of a type test is to be found in the practice of making castings with projecting portions, which are eventually cut or sawn off and tested for mechanical, physical or chemical characteristics or for two or three of them. It is probable that the data obtained in this way apply also to the casting; the latter, however, would be destroyed in similar tests. The value of tests on samples depends on the skill with which the pieces were located and if the metal were poured so as to ensure a uniform cooling rate with the main body of the casting. More trustworthy data are obtained by testing metal cut from the main body of the casting. In important parts this is often done by trepanning out a piece where a hole is required. The closer that such samples are taken from the metal which will be used, the nearer is the test to a true test.

In electrical work, analogous type tests can be found in Brit. Spec. 137 (1930), which deals with porcelain line insulators. In these tests for ascertaining the puncture and porosity figures, the insulator is destroyed in the process. The mechanical, electro-mechanical and temperature-cycle tests are carried out on a proportion only to save time and expense. Mechanical tests must, from their nature, be made on insulators one at a time, while temperature cycle tests cannot be made in less than six hours, and are very awkward to carry out with more than a few units at a time.

Skilled craftsmanship plays a greater part in porcelain manufacture, both in the moulding and the firing, than it does in the production of rolled or drawn metal. This is reflected in the incidence of tests. A simple set of tests would usually satisfy a purchaser of several tons of rolled steel, but of the insulators 0·5 per cent is the minimum standard quantity tested. If in these a failure is recorded, a second batch of 1 per cent is tested. A failure on the second group of tests is followed by tests on 1·5 per cent, and if there are defects among these, the whole quantity is rejected. The increasing size of the batch tested is a clear indication of increasing suspicion about the quality of the bulk. In more readily controlled materials it is not usual to increase the percentages tested, even if failure does occur in the initial batch.

Electrical work presents also another class of type-tests such as in those made to determine the impulse voltage characteristics of an insulator or bushing. The impulse ratio depends almost completely upon the physical dimensions and the relative dispositions of dielectrics and conductors in such apparatus. Without changing these features, there is practically nothing that can be done in course of manufacture which would sensibly alter the impulse breakdown values. Thus a type-test on any one of a batch of dimensionally similar units is adequate to prove the characteristics of all. It is, in fact, a purely design test.

The tests carried out by the Home Office Mines Departments at Buxton, to prove electrical apparatus safe for use in explosive atmospheres, are also in this group. Inspection which shows identity of detail conveys full confidence that duplicates of the tested apparatus are equally flameproof.

Recently, the industry has become increasingly aware of a new group of type-tests, namely, those made on circuit breakers, which are covered by certificates issued by the Association of Short-Circuit Testing Authorities or the National Physical Laboratory. These two bodies are now working in conjunction to carry out and certify the short-circuit type-tests made in conformity with the requirements of Brit. Spec. 116 (1937). This standard specification calls for other tests also, but these are of a well-understood nature and may be made with apparatus found in any properly equipped factory.

The over-voltage tests on insulation and those made to check the operation of tripping and closing coils, are carried out on every breaker as a matter of routine. Hydraulic tests to prove tank strength and adequacy of joints need not necessarily be made on every breaker. This also applies to the mechanical endurance test, which consists of opening and closing the breaker 500 times on no-load. A test of this kind is necessary on any complicated mechanism, to ensure that some trifle, which might cause ultimate failure by excessive wear or distortion in service, has not been overlooked in design.

The practical circumstances in which a breaker may have to perform vary widely, and the accompanying electrical and physical phenomena are very complex. It is impossible, therefore, to separate the short-circuit tests into a series, each of which is simple and clearly defined, as can be done, for example, with an insulator. The only possible method of carrying out these tests is to use a testing generator which has short-circuit characteristics like those of the largest power stations. The operation, control, and recording work with such call for technical skill of an uncommon and very high order. The type-tests that have been devised are of an all-embracing character, and represent the worst that could happen in service; they are far more severe than is likely to occur in the majority of cases. It is essential to do this, because the primary duty of the breaker is to protect all other connected apparatus.

It will be generally agreed that the proper fields for type-testing are: (*a*) whenever the process of testing must destroy the article; (*b*) whenever the test is to determine a characteristic which is dependent upon dimensions and physical positions of parts; and (*c*) whenever individual testing would increase the cost of the finished article to an uneconomic level.

DUGGAN-CRONIN BANTU GALLERY, KIMBERLEY

WHEN in 1929 the British Association visited South Africa, the anthropologists in particular were much impressed by the scientific value, as well as by the importance as a record, of the collection of photographs of characteristic types of the native races of South Africa, which had been formed and was still being augmented by Mr. A. M. Duggan-Cronin. This impression was fully confirmed by further examination of the material placed on exhibition by Mr. Duggan-Cronin at the centenary meeting of the Association held in London in 1931.

Mr. Duggan-Cronin's interest in native types was first aroused when, as an employee of the De Beers Company in Kimberley, he was brought into contact with the wide variety of tribesmen who sought employment in the mines. After mastering the technique, he began his photographic series of racial types in 1904; but it was not until 1919 that he was able to undertake work in the field, when at the instance of the Board of the McGregor Institute, Kimberley, he visited the Langenbergen, Griqualand West, to photograph the Bushmen living there. Since that time, each year Mr. Duggan-Cronin, with the financial assistance of the Union Research Grant Board or from the Carnegie funds, has carried on his work, visiting one or other of the South African peoples, until a record has been made of every important Bantu tribe in the Union and of a number elsewhere, as well as of the Yellow races, Bushmen and Korannas. These records, to the number of 2,600, have been mounted in albums and the negatives stored in a strong room of De Beers. The material has also been published in part in eight volumes with the Cambridge University Press, while seven further volumes await publication.

From 1925 onward Mr. Duggan-Cronin, in view of the fact that no Bantu gallery existed in South Africa, threw his collection open to the public, maintaining the gallery at his own expense. After twelve years, however, it was offered as a gift to the town of Kimberley, subject to the provision of suitable housing. The gift was accepted and the collection was officially declared open in 1938 as the Duggan-Cronin Bantu Gallery by Sir Ernest Oppenheimer, chairman of De Beers Company, in premises, formerly the guest house, generously provided by that company, together with £150 per annum towards the cost of upkeep.

The unique character of many of these photographs as records from the cultural, as well as the racial point of view, was the subject of commendatory reference at an exhibition which was held at a recent joint meeting of the Rhodesia Scientific Association with the newly formed Rhodesia Photographic Society at Salisbury (*Transactions*, 37 ; 1939), when attention was directed to, among others, the complete series illustrating the smelting of iron ore among the Mashona, and the initiation ceremony of the Bomvana Kwetas. In the Bantu Gallery at Kimberley the photographs are supplemented and further illustrated by objects of the tribal culture collected by Mr. Duggan-Cronin.

THE EARTH'S INTERIOR

K. E. BULLEN has examined the recent developments in knowledge of the earth's interior (*Acta Astronomica*, 4, April 1939). The most recent estimate of Gutenberg and Richter shows a radius of the core of 2,920 km., and work on near earthquakes suggests the existence of various crustal layers extending to a depth of the order of 30 km. from the surface of the earth. According to Bullen, if the variation of density between the earth's crustal layers and the central core were continuous, the moment of inertia of the central core wouldhave to be $0 \cdot 57\ Ma^2$, where M is mass of core and a is radius of core. This, being in excess of the value $0 \cdot 40\ Ma^2$ which would hold for a homogeneous sphere, would appear to indicate a virtually impossible distribution of matter inside the central core. Thus some assumption made in obtaining these estimates appeared to need amendment. The amendment suggested by Bullen is that there is a change of material at a depth of the order of several hundred kilometres.

On account of the 20° discontinuity in the travel time graph of P waves from earthquakes which appears to be fairly well established, Jeffreys has suggested either an abrupt change at a depth of 474 km. (uncertainty 20 km.) or an appreciable variation from 300 to 700 km. below the earth's surface. Incidentally, 700 km. gives the depth of focus of the deepest focus earthquake yet recorded. Price and Lahiri have recently suggested a change of material at a depth of approximately 700 km. in the earth on the evidence of variation of electrical conductivity. Following work by Olczak, Jeffreys, Bernal, Benfield and himself, Bullen suggests the following distribution of matter within the earth :

	Depth	Density range
Normal olivine layer	30 474 km.	3·32–3·69 gm. cm.$^{-3}$
Cubic olivine layer	474–2020 km.	4·24–5·57 ,,
Central core	2920–6371 km.	9·77–12·29 ,,

Concerning further density changes within the earth, Gutenberg and Richter have recently directed attention to the possibility of variation within the core itself.

SEVENTY YEARS AGO

NATURE, vol. 1, April 14, 1870

Left-handedness

"J. S." in a letter to the Editor concludes : "Left-handedness is very mysterious ; it seems quite against physiological deductions and the whole tendency of arts and fashion. Prof. Buchanan, of Glasgow, who wrote an able memoir on right-handedness in 1862, thinks that left-handedness may be due to transposition of the viscera, and tells me that his friend Dr. Aitken found such a case. But surely transposition of the viscera must be far rarer than obstinate left-handedness. In cases of left-handed persons which I have examined, the links of the left side were proportionally larger, just as those of the right side are in normal cases. I have also found that left-handedness is hereditary".

Heat Units

THOMAS MUIR, writing from College Hall, St. Andrews, refers, in a letter to the Editor under this title, to the cumbersome terminology used to describe "units of heat", and makes the following comments.

"Define, first, as follows :—A *therm* is the quantity of heat necessary to raise the temperature of 1 gramme of water from 0° C to 1° C. Secondly 1 kilotherm = 10 hectotherms = 1000 therms = . . . , thus having kilotherm, hectotherm, &c., suggestively corresponding to kilogramme, hectogramme, &c., in name as well as in nature.

"Therms and kilotherms, which would probably alone be required in practice, would thus take the place of 'thermal units, centrigrade', 'gramme-water-units', 'kilogramme units of heat', and others more or less lengthy and inexact at present to be found in writing, on Heat and Energy."

Postage on Printed Matter

THE Budget contains an announcement "of the greatest importance to men of science. The postage on printed matter not exceeding 2 oz., and on newspapers not exceeding 6 oz., is to be reduced to one halfpenny. We have waited a long time for this change : not too long, however, to welcome it warmly now it has come, for the tax on all authors of the postage of the scientific papers, copies of which they wish to distribute, has been very great."

AT the anniversary meeting of the Chemical Society held on March 30, the president, Dr. A. W. Williamson, announced in his address that Messrs. Johnstone and Matthey had offered the Society a donation of palladium to be used for the preparation of the first ten Faraday Medals.

THE honour of knighthood has been conferred on Mr. Ronalds for his early researches in telegraphy.

UNIVERSITY EVENTS

ABERDEEN.—On April 4, the honorary degree of LL.D. was conferred on Sir William Jameson, professor of public health, University of London, and Prof. F. A. Lindemann, professor of experimental philosophy, University of Oxford.

FORTHCOMING EVENTS

Monday, April 15

Royal Society of Arts, at 4 p.m.—Dr. L. H. Lampitt: "Science and Food" (Cantor Lectures. Succeeding Lectures on April 22 and April 29).

Tuesday, April 16

Royal Statistical Society (at the Royal Society of Arts), at 5.15 p.m.—Prof. J. H. Jones: "The Report of the Royal Commission on the Distribution of the Industrial Population".

Wednesday, April 17

Royal Society of Arts, at 2.30 p.m.—H. V. Potter: "Plastics as Constructional and Engineering Material".

Royal Microscopical Society, at 3.30 p.m.—Annual Meeting.

Dr. P. N. Bhaduri: "Improved Smear Methods for Rapid Double Staining".

Royal Meteorological Society, at 4.30 p.m.—Prof. P. G. H. Boswell, F.R.S.: "Climates of the Past, a Review of the Geological Evidence" (G. J. Symons Memorial Lecture).

Thursday, April 18

Chemical Society, at 6 p.m.—Prof. R. G. W. Norrish, F.R.S.: "Some Aspects of the Polymerisation of Vinyl Compounds".

Friday, April 19

Eugenics Society (at the Linnean Society), at 5 p.m.—Mrs. Eva Hubback: "Family Allowances".

Saturday, April 20

Association of Scientific Workers (at the Guild of Undergraduates Union, Birmingham), at 3 p.m.—Conference of Industrial Scientists. (Speakers: J. S. Hunter: "Salaries, Cost-of-Living Adjustments, Overtime"; Dr. C. J. Milner: "Holidays and the Five-day Week"; J. Skeel: "The Problems of Assistants, (*a*) General and Economic Problems"; A. G. Ward: "The Problems of Assistants, (*b*) Problems of Technical Education"; Dr. R. E. Priestley: "Science as a Reserved Occupation".

Society of Glass Technology (Meeting at Sheffield), April 16–April 17.

April 17, at 2.30 p.m.—Annual General Meeting.

Prof. L. C. Martin: "The Possibilities of the Electron Microscope".

Dr. M. Benjamin: "An Electron Microscope".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Electrical Engineering at the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (April 16).

Temporary Lecturer in charge of the Department of Physics—The Registrar, University College, Leicester (April 17).

A Graduate Assistant to teach Mathematics and General Science subjects, a Graduate Assistant to teach Mechanical subjects, and a Graduate Assistant to teach Physics, at the West Hartlepool Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (April 19).

Head of the Department of Electrical Engineering—The Registrar, Portsmouth Municipal College, Portsmouth (April 20).

Engineering Graduate to teach, principally, Mathematics, at the County Technical College, Dartford—F. L. Notley, 11 Essex Road, Dartford (April 20).

Lecturer in Agricultural Chemistry in the School of Agriculture near Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting Lecturer, A.C.) (April 25).

Head of the Department of Physics and Mathematics—The Principal, Sir John Cass Technical Institute, Jewry Street, E.C.3 (April 27).

Assistant Inspector (man or woman) of Schools in Wales—The Secretary, Welsh Department, Board of Education, Alexandra House, Kingsway, W.C.2 (April 29).

H.M. Inspectors (men) of Technical Schools and Colleges—The Secretary, Board of Education, Alexandra House, Kingsway, W.C.2 (May 4).

Assistant Inspector (woman) in Domestic Science—The Secretary, Board of Education, Alexandra House, Kingsway, W.C.2 (May 4).

H.M. Inspector (woman) of Physical Training—The Secretary, Board of Education, Alexandra House, Kingsway, W.C.2 (May 4).

Imperial Agriculturist at the Imperial Agricultural Research Institute, New Delhi—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 9/1A) (May 4).

Medical Officer (man or woman)—The Secretary, Board of Education, Alexandra House, Kingsway, W.C.2 (May 11).

Head of the Department of Chemistry—The Secretary, School of Metalliferous Mining, Camborne, Cornwall (May 15).

A Senior Lecturer in Civil Engineering, a Lecturer in Civil and Mechanical Engineering, and a Lecturer in Mechanical Engineering, at the Henry Lester Institute of Technical Education, Shanghai—Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, E.C.1 (May 18).

Engineer with good knowledge of Chemistry and Physics—The Director, British Launderers' Research Association Laboratories, Hill View Gardens, N.W.4.

Draughtsmen (Ship-Constructional, Mechanical and General Engineering) by the Ministry of Supply—The Ministry of Supply (S.E.3b), Adelphi, W.C.2 (quoting Appts. 026/S.E.3b).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 16: The Retardation of Chemical Reactions, 10: The Choice of Retarders in Liquid Phase Oxidations. By Kenneth C. Bailey. Pp. 373–412. 4*s*. Vol. 46, Section A, No. 1: A Characterisation of Algebraic Numbers. By Olga Taussky and John Todd. Pp. 8. Vol. 46, Section A, No. 2: A Method of Determining Quantum-Mechanical Eigenvalues and Eigenfunctions. By E. Schrödinger. Pp. 9–16. Vol. 46, Section A, No. 3: On Proving Certain Properties of the Primes by means of the Methods of Pure Number Theory. By T. S. Broderick. Pp. 17–24. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [213

The Higher School Certificate Examination: being the Report of the Panel of Investigators appointed by the Secondary School Examinations Council to enquire into the Eight Approved Higher School Certificate Examinations held in the Summer of 1937. Pp. 93. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [263

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1938, with Report of the Geological Survey Board and Report of the Director. Pp. iv+108. (London: H.M. Stationery Office.) 2*s*. net. [263

The National Institute of Agricultural Botany. Twentieth Report and Accounts, 1938–39. Pp. 17. (Cambridge: National Institute of Agricultural Botany.) [273

Other Countries

New Zealand: Department of Scientific and Industrial Research. Meteorological Observations for 1938. Prepared in the Meteorological Office, Wellington. Pp. 38. (Wellington: Government Printer.) [193

Southern Rhodesia. Geological Survey Bulletin No. 36: The Geology of the Country around Gwanda. By R. Tyndale-Siscoe. Pp. viii+204+15 plates. (Salisbury: Government Stationery Office.) 6*s*. 6*d*. [203

Indian Association for the Cultivation of Science. Special Publication No. 8: Interatomic Forces. By Prof. J. E. Lennard-Jones. Pp. 44. (Calcutta: Indian Association for the Cultivation of Science.) 1.8 rupees: 2*s*. 3*d*. [203

Kungl. Svenska Vetenskapsakademien: Förhistoria, Grundläggning och Första Organisation. Av Bengt Hildebrand. Pp. xv+672. Noter, Bilagor M.M. Pp. v+673–886. (Stockholm: Kungl. Svenska Vetenskapsakademien.) [203

Annual Report of the American Telephone and Telegraph Company for 1939. Pp. 38. (New York: American Telephone and Telegraph Company.) [213

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Carnegie Institution of Washington Year Book No. 38, for the Year 1938–1939.) Pp. 57–106. (Washington, D.C.: Carnegie Institution.) [263

U.S. Department of the Interior: Geological Survey. Bulletin 874–D: Geology and Fuel Resources of the Southern Part of the Oklahoma Coal Field. Part 4: The Howe-Wilburton District, Latimer and Le Flore Counties. By Thomas A. Hendricks. Pp. iv+255–300+plates 27–35. 70 cents. Bulletin 890–A: Spirit Leveling in South Carolina. Part 1: Northern South Carolina, 1896–1938. Pp. ii+455+2 plates. 55 cents. Bulletin 898–E: Spirit Leveling in Missouri. Part 5: Southwestern Missouri, 1896–1937. Pp. x+581–735+xi–xiv. 20 cents. Bulletin 905: The Coal Resources of McCone County, Montana. By A. J. Collier and M. M. Knechtel. Pp. vii+80+16 plates. 75 cents. (Washington, D.C.: Government Printing Office.) [273

Carnegie Endowment for International Peace. Annual Report for 1939 of the Division of Intercourse and Education. By Nicholas Murray Butler. Pp. 64+7 plates. (Washington, D.C., and New York: Carnegie Endowment for International Peace.) [273

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LOCATION OF INDUSTRY IN GREAT BRITAIN

THE Royal Commission on the Distribution of the Industrial Population, under the chairmanship of Sir Montague Barlow, was appointed in July 1937, mainly in consequence of the concern at the slow recovery of the Depressed Areas and the steady drift of population to London and the Home Counties. The views so strongly expressed by successive Commissioners for the Special Areas, without apparent effect, had by then been powerfully reinforced by defence considerations. The strategical dangers to which the whole country was exposed by over-development in its most vulnerable part could no longer be ignored, and the possibility of experimenting in national planning had at last to be considered seriously by the Government.

When the Royal Commission was appointed, an inquiry into the location of industry undertaken by a group of Political and Economic Planning had already reached an advanced stage. The latter inquiry, in view of its relation to the work of other P E P groups, was nevertheless carried to a conclusion and its report was published in March of last year. It is not surprising, therefore, that the recently published report of the Royal Commission, a summary of which appears elsewhere in this issue, provides little additional information, but nevertheless it gives us an able and well-balanced survey of the situation.

Both in the basic facts which are set forth and in the conclusions and recommendations deduced from them, the two reports have much in common. Where the Planning Group of P E P recommends the creation of a permanent Industrial Development Commission for the specific purpose of guiding the location of industry and advising the Government on the subject, the majority report of the Royal Commission recommends the appointment of a National Industrial Board, with mainly advisory powers except in regard to regulation of industrial location in London and the Home Counties. There is, however, a wide divergence of opinion among the members of the Royal Commission in regard to the functions to be exercised by the central authority. Three of the ten members who sign the majority report do so with reservations which would bring the functions of the proposed Board closely into line with those of the Development Commission recommended in the P E P report. The remaining three members of the Commission go even beyond the P E P report, which suggested that a senior Cabinet Minister without departmental duties should be responsible to Parliament for the activities of the Commission, and recommend the establishment of a new ministry, taking over not only the functions of the Commissioners for the Special Areas, but also some of the functions of the Ministry of Health and Ministry of Transport.

This sense of urgency and note of conviction, which characterize both the reservations and the minority report, give a value and reality to the outcome of the Commission's labours which would otherwise be sadly lacking. Without them it could scarcely be said that the report does more than give us a fresh and convenient presentation of facts already widely known, leading to conclusions previously reached by many thoughtful observers and students of problems of industrial location or planning. The bare majority of the Commission appears to falter just where decision and action are most needed, and the ably argued reservations of Prof. J. H. Jones, Mr. G. W. Thomson and Sir William Whyte in the minority report are likely to carry much more conviction with scientific workers.

The signatories of the minority report regard the excessive concentration of population in London and other large conurbations as more a symptom of the main disease than as an evil in itself, although socially and strategically they agree with the other commissioners that it is an evil which requires remedying at the earliest possible moment. They urge, therefore, that positive action by way of regulating new industrial development throughout Great Britain is a more essential and effective way of treating the problem than simple restriction of the industrial growth of a particular area. A beginning must be made in treating the country as a social and economic unit as well as a political unit.

The logic of such a policy can scarcely be denied if there be agreement on the basic facts from which it is derived. Moreover, only continuous study by the new Board of the problem of achieving a well-balanced industrial society can obviate the creation or perpetuation of areas of great distress in the near future. The facts assembled in the report should finally dispose of any lingering contention that we can rely on unguided or uncontrolled private industry in such matters without detriment to the social, economic, and strategic interests or amenities of the nation. The unassailable fact demonstrated by this report, like that of the PEP report, is that apart altogether from the difficulties and complications of co-ordination and clashing of interests, neither the industrialist nor the individual Government department has usually anything like the amount of information required for a sound decision as to location. Decisions based on a partial knowledge of the facts have been invalidated by unforeseen developments elsewhere with consequences no less disastrous to the enterprise itself than to the district and community in which it was mistakenly placed.

For such reasons as these there is general agreement that a beginning should be made with London ; but the experience gained with restrictive powers in that region should be used from the start as a guide in preparing a scheme to be applied to the whole of Great Britain. No district should be considered or dealt with other than as one part of a national problem, and the whole experience of the past few months of war endorses the urgency of the minority argument or reservation on this point in the report. Accordingly, once the necessity of conferring immediate executive powers on the proposed Board in respect of London and the Home Counties is admitted, it appears to be illogical to withhold the general executive powers which are advocated by six out of the thirteen members of the Royal Commission.

The difference between the bare majority and the remaining members of the Royal Commission appears to be much more profound than is indicated by mere reservations. Having regard to the urgency of the problem, accentuated by all the disturbance of civil life which the War has since occasioned, the choice between advisory powers and executive powers may make all the difference between success or failure in the formulation and execution of an adequate plan.

This point of view is endorsed by the experience of the Commissioners for the Special Areas. Evidence submitted to the Royal Commission showed not only that the Commissioners had made the fullest use of their powers and opportunities, but also that their powers had been too rigidly defined and were too restricted in scope. The solution to the problem of the Special Areas does not necessarily lie within the defined geographical limits of such areas, any more than the problem of location of industry can be separated from the national problem of persistent unemployment. Moreover, the Commissioners for the Special Areas are not empowered to do more than endeavour to remedy—or mitigate—a serious evil that has already appeared. Anticipation and prevention lie outside their province.

These considerations led the minority of the Commissioners to recommend that the essential powers and responsibilities of the Commissioners for the Special Areas should be transferred either to the new Board recommended in the majority report, or to the new Ministry recommended in the minority report, and that they should be extended to cover the whole of Great Britain. The basic purpose of such extension is to provide preventive rather than curative action, so far as possible, and the intensity of armament production at the present time emphasizes the warning that, in the absence of such preparation for the future, the problems of the past will reappear, and become even more serious in extent and more difficult to solve.

This is indeed one of the dominant notes throughout the reservations and the minority report, and a basic consideration in putting forward recommendations for wider executive powers and immediate action. A policy of drift is likely now, even more than when the report was written, to lead to the perpetuation and exaggeration of existing evils. The continuance of ineffective control may also result in irremediable damage to the countryside and amenities through unrestricted despoliation and haphazard development arising out of evacuation, decentralization and the building of camps, whether civil or military.

The salient feature in the existing situation is that little, or in any event insufficient, attention has been given to the problem of the best distribution of industry in Great Britain as a whole. Not only are the town planning schemes local by definition, but also much of the basic knowledge required to guide industry in the choice of sites is lacking. The necessity for unified research into the problem of distribution on a national scale is widely recognized. On this, and on the necessity for a unified plan of distribution based on the results of such research, and for effective control meanwhile of such changes in distribution as must continue to take place in the interests of trade, the Royal Commission is virtually unanimous. The minority only differs from the majority in considering that this task, which is both national and local, is of sufficient importance to call for the creation of a new separate Ministry, on the same principle as that on which separate Ministries have been created in the past for the partly national and partly local services of education and transport.

The divergence of views on the Commission in regard to the urgency and machinery of Government action should not be allowed to overshadow the basic fact that the Commission is unanimous in its nine main conclusions as to the objectives of that action. Moreover, the evidence demonstrated the existence of a large body of opinion in favour of some regulating action along national lines and in the national interest. It is indeed possible to regard the essential difference between the majority and minority recommendations as consisting in the greater regard had by the former to action which is immediately practicable, rather than to that which is theoretically desirable but would demand further educational effort to secure adequate support.

If, therefore, the wider vision and longer range objectives which characterize the minority recommendations are kept in mind, adoption of the majority report and action along the lines advocated by it is more likely than not to prove a stepping stone to the wider and more extensive powers contemplated by the remaining Commissioners. The task of education can proceed *pari passu* with such action, and the impetus to regionalism which the report can scarcely fail to give—which has indeed already been given by civil defence and other emergency measures in war-time—should further assist in that process.

What has to be kept in mind is the importance of immediate action. The report must not be merely shelved until after the War. The nation cannot afford to leave great industrial areas of the country derelict and allow development to repeat the process elsewhere. There is no guarantee that the new and expanding industries of to-day will not be the depressed industries of to-morrow if allowed to develop without control. Moreover, developments proceeding in war-time require co-ordination and control if the problem is not to become even more intractable, with further waste of national assets, spoliation of amenities, injury to national health and destruction of the countryside.

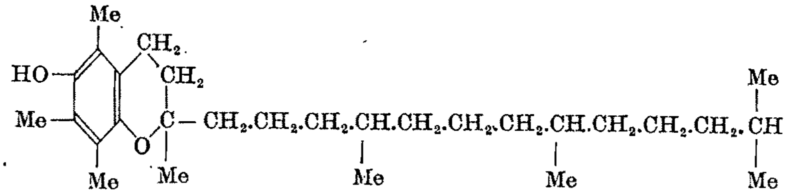
The report has therefore the strongest claims on the attention of all who are concerned with the scientific utilization and conservation of national resources in the widest sense. The co-operation of scientific men is essential in much of the basic research work required and in the elaboration of the necessary plans for development. On a score of technical questions it will fall within their competence to give the appropriate data. Above all, the problem must be considered in relation to that task of reconstruction which will confront us urgently at the end of the War, and possibly the more imperatively the longer the War lasts. We cannot afford to wait until irreparable damage is done, and solutions have to be found urgently and decisions made under duress and with no sound basis. The extensive and realistic research and planning upon which peaceful change depends, whether in national or international affairs, cannot be improvized in a moment. The location of industry is typical of those problems which must be visualized and handled before they become chronic or acute, and before their reactions on other problems multiply. Already, as the report shows plainly, the maldistribution of the industrial population of Great Britain has reached a point when it may easily become intractable.

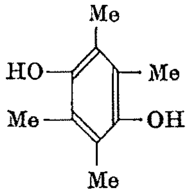
The problem is a vital part of our war effort, and if that is to attain its maximum efficiency and the subsequent task of reconstruction is not to be hindered, it must be faced at once. The report of the Barlow Commission points out certain possible lines of immediate advance, and provides fresh material with which to win the support of the community for progressive measures in dealing with the distribution of the industrial population of Great Britain.

VITAMIN E

Vitamin E
A Symposium held under the auspices of the Food Group (Nutrition Panel) of the Society of Chemical Industry on Saturday, 22nd April, 1939. Pp. viii + 88. (London: Society of Chemical Industry, 1939.) 5*s*.

VITAMIN E was discovered in 1922. Experiments which had been conducted in three different laboratories in the United States revealed that female rats failed to reproduce when kept on certain artificial diets, although these contained the four vitamins then recognized, A, B, C and D. Evans and Bishop of the University of California pointed out that another vitamin was involved. It was named first vitamin X and later vitamin E.


Vitamin E (α-tocopherol)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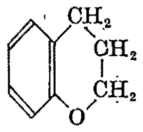
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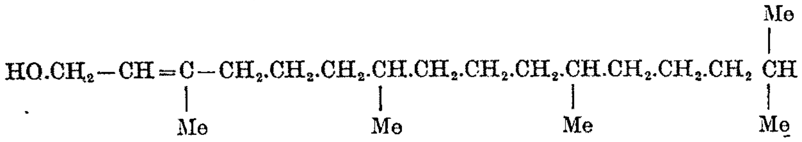

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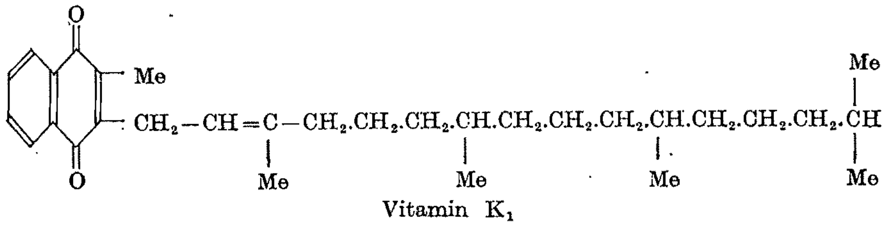
Phytol


Vitamin K₁

STRUCTURAL FORMULÆ, SHOWING RELATIONSHIPS BETWEEN VITAMIN E (α-TOCOPHEROL), DUROQUINOL, CHROMAN, PHYTOL AND VITAMIN K₁

The first detailed study of the vitamin was made by Evans and Burr. They showed that in the absence of the 'anti-sterility vitamin', as it was commonly called, gestation was terminated after about two weeks by the resorption of the fœtus. This sterility of the female could be cured if vitamin E was restored to the diet. In the male rat a degeneration of the germ cells occurred, which was less readily curable, or even incurable. Evans and Burr found that the vitamin was present in a number of natural vegetable oils such as those of wheat germ, rice germ, cotton seed and in lettuce leaf. It occurred in the unsaponifiable fraction of the oils. Animal products contained only traces.

For about a decade after the publication of Evans and Burr's monograph in 1927, there was little further advance to record. Then in 1936 Evans and his colleagues announced that they had at length succeeded in isolating from wheat-germ oil two substances which possessed the biological properties of the vitamin. These they named α-tocopherol and β-tocopherol, signifying 'alcohol promoting child-birth'.

In the past couple of years progress has been striking. Not only has the structure of α-tocopherol (and of related substances) been established, but also it has been synthesized and the synthetic product has been proved to be as active as the natural one. α-Tocopherol is related structurally to duroquinol, and has a fused ring system of the chroman type, an interesting feature being the presence of the phytol residue which is found also in chlorophyll and in vitamin K_1, the so-called coagulation factor. In other directions, too, there have been important developments. For example, we now know that a continued lack of vitamin E leads to a variety of ill-effects in addition to sterility. Then again, methods have lately been introduced for the chemical assay of the vitamin which in time may be able to replace the laborious biological test. Or, to take a third example, much interesting work has been done on the relation between chemical structure and biological specificity.

There was an obvious need to bring together and collate all these recent achievements, and the indefatigable officers of the Nutrition Panel of the Society of Chemical Industry put all biologists and chemists in their debt when they organized last spring a symposium on vitamin E, which many of the leading workers of the world attended and to which they contributed authoritative accounts of their investigations. The Society has done well to publish *in extenso* the proceedings of this symposium, and the booklet recently issued is virtually a monograph dealing with vitamin E from almost every angle. The editors, Mr. A. L. Bacharach and Prof. J. C. Drummond, have carried out their task conscientiously and effectively, and the value of the work is increased as a result of their efforts of co-ordination and particularly by the provision of the complete alphabetical bibliography.

The text is divided into three parts dealing with the chemical, physiological and clinical aspects respectively.

In the opening paper, Prof. A. R. Todd gives a valuable review of the organic chemistry of vitamin E and related substances. The question of biological specificity is next discussed, by Prof. P. Karrer of Zurich and Dr. F. Bergel. Their main conclusion is that for maximum biological activity the presence of the long aliphatic side chain is essential. In the aromatic nucleus the presence of all three methyl groups is most favourable, for with but one methyl group there is only a low degree of activity. Ethyl has an unfavourable influence. Drs. Emmerie and Engel, of the University of Utrecht, give an account of the promising chemical test which they have introduced, depending on the reduction of ferric chloride by the vitamin and the estimation of the resultant ferrous ion by means of 2 : 2′-dipyridyl. This reaction can apparently be made relatively specific, and will estimate as little as 5 μgm. of tocopherol; it can probably be applied to blood. A critical comparison of this and other chemical and biological methods is given by Dr. E. Lester Smith and Mr. R. Bailey. They found that the chemical methods are prone to overestimate the activity of concentrates but to underestimate that of oils.

On the physiological side, one of the most interesting suggestions is that vitamin E is needed for the normal functioning of the anterior lobe of the pituitary gland. Evidence in favour of this theory is well set out by Dr. S. W. F. Underhill, but the connexion is by no means universally accepted. For example, Prof. J. C. Drummond in his lucid review prefers to take a more cautious line, and as he says: "We are still fumbling in the dark trying to find some clue to the hormonal disturbance responsible for the characteristic failures of the reproductive system in vitamin-E deficient rats." In this connexion Drummond alludes to the work of Karl Mason, another contributor to the symposium, who has cogently pointed out that the type of testicular degeneration seen in vitamin-E deficiency is unique and does not at all completely resemble that which can be produced by hypophysectomy or that following prolonged administration of œstrogenic substances.

A few years ago, vitamin E was known only by the effect of its deficiency on reproductive function. Now at least half a dozen further symptoms are recognized, of a rather ill-assorted character. These include muscular dystrophy, degeneration of muscle fibres leading to discoloration of uterus and seminal vesicles, a characteristic degeneration of the convoluted tubules of the kidney, a so-called 'alimentary exudative diathesis', subnormal growth, and failure to store vitamin A normally in the liver. Dr. Thomas Moore and his colleagues deal succinctly with some of these aspects of vitamin-E deficiency. It must be admitted that we are still without any explanation of the cause of these surprisingly varied manifestations. The physiological section of the symposium closes with an able contribution by Mr. A. L. Bacharach discussing the whole philosophy and application of biological standardization. He rightly condemns 'biological units', such as 'rat units', 'mouse units', etc., and remarks: "In the modern sense of the word this is not a unit at all; it is simply the reciprocal of a dose that had a certain effect on a certain animal at a certain time". The objection to 'biological units', of course, is that animals vary. "Animal variation is merely a polite term for the integrated incompetence of the investigator, its effect is to deprive the so-called 'biological unit' of even roughly quantitative significance." The moral, needless to say, is to use specified amounts of fixed standard preparations as units.

On the clinical side, it must be confessed that most will feel themselves forced, however unreadily, to agree with Prof. F. J. Browne that the claims which have been made remain unproved for the greater part. True, it has been contended that therapy with vitamin E has given 75 per cent of successes in habitual abortion, or 68 per cent in threatened abortion, or 41 per cent in defective lactation. There is, perhaps, nothing inherently unlikely or even improbable in these claims. The only 'snag' is the absence of untreated negative controls. Browne points out, on the authority of Malpas, that after one, two or three spontaneous abortions, the chances of the next pregnancy being carried to term are 78, 62 and 27 per cent, *even in the absence of any specific treatment.* This has scarcely been taken into account in assessing the value of vitamin-E therapy. Browne, indeed, refers to a controlled test by Boycott in which the seven negative controls all 'responded' although receiving no treatment at all! Still more recently, vitamin E has been recommended for the treatment of muscular dystrophies and even of tabes. The last-mentioned disease seems to be included more as a matter of faith than as a result of successful accomplishment. In the opinion of the present reviewer it would be a help for the future if the conjecture of a deficiency of vitamin E in a given disease, and the accompanying suggestion for therapy, could be backed up by chemical tests on the patient's blood to establish the actual occurrence of a low level of nutrition.

It has not been possible in this review to touch on all the varied ground covered in the symposium, but it must be evident that no worker on vitamins and nutrition can afford to be without it.

LESLIE J. HARRIS.

THE DOMAIN THEORY OF MAGNETIZATION

Ferromagnetismus
Von Prof. Dr. R. Becker und Dr. W. Döring. Pp. vii + 440. (Berlin: Julius Springer, 1939.) 42.60 gold marks.

IT is very unfortunate that this important work should have appeared at such an inopportune moment in the world's history, when it will be difficult for most of the English-speaking peoples to obtain copies of it. Those of us who had the pleasure of meeting Prof. R. Becker at the 1939 Conferences on Magnetism in Bristol and in Strasbourg must sympathize with him in no small measure. In this work Dr. Döring and he have put forward in a very complete manner the whole series of interesting ideas on the processes of magnetization which have emanated from Göttingen during the present decade.

Prof. Becker gave a series of lectures in the winter of 1934–35 under the auspices of the Technische Hochschule at Berlin to an audience consisting in the main of technicians, who, no doubt, keenly appreciated accounts of the work of Becker and his collaborators on the relation between stress, magnetostriction and direction of magnetization as exemplified by experiments on nickel under tension.

The present book owes its origin to the success of those lectures. Its scope may be summarized as follows. It seeks to give a brief survey of the Weiss conception of domains in a ferromagnetic which are spontaneously magnetized more or less to saturation, and of those problems of academic interest, such as the variation of spontaneous magnetization with temperature, upon which the conception bears. It seeks mainly, however, taking the Weiss conception for granted, to explain those magnetic properties of ferromagnetics which are of great technical importance, such as the shape of the hysteresis curve, in terms of the alignment or growth of Weiss domains in favoured directions. In fact, the book might almost be described as a treatise on the technical aspects of the domain theory of magnetism. The reviewer was therefore a little surprised to find no mention in the book of Stoner's stimulating discussion of the effects of domain size, although it is only fair to add that the effects of domain size are at present of less interest in technical than in academic work on magnetic saturation, and the reviewer has noticed no other omission of any import.

The book does not avoid mathematical arguments whenever necessary, and although these are profusely supported with experimental results, the book requires some power of concentration of the reader if it is to be read with profit. However, a fundamental discussion of the different processes which play a part in technical magnetization, in magnetostriction, in the determination of high initial permeability, in Barkhausen discontinuities, in permeability at high frequencies and so on, cannot be treated with ease. The authors have indeed performed a most useful service in placing the present theory before us in such a complete manner and in correlating so many experimental facts with the theory. Some of the theory clearly needs amplification; for example, what may be termed the Döring theory of large Barkhausen discontinuities is really a theory for a metal in two dimensions only, and, as Stoner pointed out at the Bristol Conference, it is difficult to picture what happens when we think of the domains in the three dimensions of the solid material. Again, in spite of all that has been written in the publications of learned societies about the heat liberated in hysteresis processes being equal to $\int H.dI$, we still cannot calculate the quantity of heat which is dissipated in a piece of iron when it is subjected to a partial change in magnetization, as distinct from a complete cycle, under normal experimental conditions.

A valuable section of some fifty pages is devoted to commercial ferromagnetic materials and their applications, wherein the problems of precipitation hardening and the effects of tempering in the presence of a magnetic field are discussed. The book is of definite interest to all concerned with technical applications or the production of ferromagnetics. It deserves every success, and one cannot but deplore that the increase of our knowledge which the authors have tried to bring about should be so unfortunately held up by others of their tongue but not of their spirit. L. F. Bates.

A THEORY OF PROBABILITY

Theory of Probability
By Dr. Harold Jeffreys (International Series of Monographs on Physics.) Pp. vii + 380. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 21*s.* net.

In his "Scientific Inference", Dr. Jeffreys has already adumbrated his approach to the theory of probability. The present book is a more systematic presentation of his views, beginning with the formulation of axioms, developing a theory of probability, describing and illustrating its use in testing significance and in estimation, and concluding with two chapters on the weaknesses of other theories and on some general scientific questions.

Probability to Dr. Jeffreys means something more than the proportion of events of a certain type in a series or an aggregate; he takes it in the wider sense of a measure of degrees of reasonable confidence in the truth of a proposition. His principal problem in his treatment of the foundations is accordingly to establish the validity of representing degrees of reasonable confidence by numbers. He overcomes it by an axiom to the effect that for any three propositions, p, q, r, the statement "on data p, q is more probable than r" has a meaning—in other words that probabilities are orderable. Now, most statisticians would accept this axiom without question, because their probabilities are *defined* as numbers; but one may fairly hesitate over the claim that Dr. Jeffreys' probabilities, which relate to attitudes of uncertainty of mind, can be ordered. There does not seem to be much in our present knowledge of mental states to support an assumption that judgments in probability are linear.

If Dr. Jeffreys' first axiom is accepted, the rest of his foundational material follows naturally enough. Having got his probabilities ordered in a straight line, he succeeds in imposing a metric on them, and in deriving the ordinary rules for addition and multiplication. He also obtains as a theorem the result which has caused so much trouble since Bayes gave it in 1763,

$$P(q_r \mid pH) \propto P(q_r \mid H) \quad P(p \mid q_rH),$$

that is, the probability of q^r given p and H is proportional to the probability of q_r given H multiplied by the probability of p given q_r and H. Dr. Jeffreys calls the factor on the left in this expression the *posterior probability*, the first factor on the right the *prior probability* and the remaining factor the *likelihood*. This result is the foundation stone of his theory. It is, he says, the chief rule involved in learning from experience.

In order to make any practical use of Bayes' theorem it is essential to decide on the values to be assigned to the prior probabilities. Bayes and Laplace postulated that in the absence of definite knowledge they were to be assumed equal. This "equidistribution of ignorance" has been relentlessly attacked in recent years, chiefly by statisticians; but Dr. Jeffreys defends it in a novel and interesting approach. The statistician's criticism is misconceived because he insists on thinking in terms of frequencies. But when Dr. Jeffreys, considering a parameter θ which may vary from $-\infty$ to $+\infty$, writes for the prior probability $P(d\theta \mid H) \propto d\theta$, he does not mean that an assumption is being made about the equidistribution of θ in the universe. He merely means "I know nothing about θ". It is his way of giving to airy nothing a local habitation and a name. This avoids most of the statistician's criticisms; but it gets Dr. Jeffreys into some new difficulties. For example, when θ is known to lie between zero and infinity, the corresponding way of saying nothing about its prior probability is $P(d\theta \mid H) \propto d\theta/\theta$. Why it should be necessary to use the notion of a reciprocal in order to express ignorance about a parameter is far from clear to me, although Dr. Jeffreys puts up a long case for the formula.

In his treatment of estimation and significance tests Dr. Jeffreys is concerned with laws containing a certain number of unknown parameters. A significance test is a method of deciding whether any given law is adequate to express observational data, or whether further parameters are required. Estimation is the determination of the most probable values of such parameters as are shown by significance tests to be necessary. Dr. Jeffreys' discussion of the many problems involved is difficult to describe succinctly; but his methods all involve a comparison of the probability of a hypothesis q with that of not-q. The ratio of these two probabilities is denoted by K. It corresponds to what the orthodox would describe as the odds in favour of q.

For the expression of K in numerical terms it is necessary to determine the prior probabilities of hypotheses. Suppose, for example, a test is being made whether a given law fits given data. It is assumed that any new parameter α which might be required is so chosen that the given law is reproduced if $\alpha = 0$. In such a case Dr. Jeffreys would assign half the prior probability to the hypothesis $\alpha = 0$, and distribute the remainder equally over the range of α. Thus $K = P(\alpha \mid pH)/P$ (not-α $\mid pH$) where p is the observational data. By Bayes' theorem the probabilities of α and not-α are expressible in terms of the assumed prior probabilities and the calculable likelihoods; and hence K results.

Anyone who rejects this approach can console himself with some comparisons made by Dr. Jeffreys with alternative procedures in use by statisticians, particularly the method of maximum likelihood. It is shown that for large samples the latter method gives much the same results as Dr. Jeffreys'. The hypothesis which maximizes the likelihood will, within permissible limits, be the one with the greatest posterior probability. And so the bridge between Dr. Jeffreys and Prof. R. A. Fisher is built—for large samples.

Dr. Jeffreys' criticisms of the frequency theories of probability centre around the necessity of justifying the application of the frequency definition to practical series by an appeal to probability itself. Dr. Jeffreys rejects such theories; and indeed it is hard to see how any writer on fundamentals can tolerate the intellectual discomfort which some of them arouse. But there is a Scylla to this Charybdis. Dr. Jeffreys' probabilities are measures of belief, not frequencies. Why, then, should he accept them as the basis of rational action? By assuming that, on the whole, what we believe is right, or as the author has put it elsewhere, "It is possible to learn from experience". It is essential for his theory that, proverbs notwithstanding, the expected usually happens. What is the basis for our ready acceptance of this postulate? The adherent to frequency theories will claim that it is an extrapolation of experience of the frequencies of events.

The reactions of one writer on probability to another being naturally exothermic, it is to be expected that Dr. Jeffreys' strictures on the naiver theories of probability will not pass unchallenged. It would be a great pity if the importance of the issues at stake were to be fogged by ill-considered criticism. Dr. Jeffreys' views deserve the most serious study. They may not be right; but they are more tenable than many statisticians have been willing to concede in the past, and it is hoped that this book will be widely read.

M. G. Kendall.

PLANT PERSONALITIES

Plants with Personality
By Patrick M. Synge. Illustrated with Plates from Dr. Thornton's Temple of Flora and with Drawings by John Nash. Pp. 244 + 20 plates. (London: Lindsay Drummond, Ltd., 1939.) 12*s*. 6*d*. net.

THIS is not everyone's book. Mr. Synge is a mystic and looks at the world of plants through metaphysical spectacles. His introduction would do credit to a treatise on Hegelian idealism. Plants, for him, "live, they grow; they are real, yet they are something more than real and we can all see it". The reader who accepts this approach, and the rather highly coloured writing to which it leads, will find much in the volume to entertain him.

Mr. Synge has selected a series of plants which appeal to him as possessing "definite personalities", and has described his reaction to them under such chapter headings as "Sun Lovers of South Africa", "Fierce Wonders from Chile", "Children of the Mexican Sun", etc.

Mixed with the purple patches, the author contrives to convey a considerable amount of valuable information on the history, distribution and horticultural treatment of his subjects. Mr. Synge's facts are usually accurate. In his section on the *Victoria regia*, however, he does not describe the remarkable change of colour from pure white to deep rose as the flower fades, and there are a number of misprints, including *Œnothera teraxicifolia* for *taraxicifolia,* despite a note on the derivation of the word.

The author has seen many of the plants mentioned himself in their native countries, and the best chapter in the book is, perhaps, that on the giant plants of the East African mountains which he visited recently with the Natural History Museum expedition.

One of the most striking features of the book are the illustrations. These are taken partly from Thornton's "Temple of Flora", partly from other botanical works, partly from original drawings by John Nash and partly from photographs. It is a pity that the source of each illustration is not more clearly indicated. John Nash's drawings are delightful, that of *Puya alpestris* being a masterpiece of its kind. Mention might have been made of Miss North's painting of Puya in her gallery at Kew.

As a bedside book for gardeners and botanists, Mr. Synge's volume will no doubt appeal to a wide circle of readers. J. S. L. Gilmour.

PHOTOCHEMISTRY

Photochemistry and the Mechanism of Chemical Reactions

By Prof. Gerhard K. Rollefson and Dr. Milton Burton. (Prentice-Hall Chemistry Series.) Pp. xiv + 445. (New York: Prentice-Hall, Inc., 1939.) 5.75 dollars.

The task of writing a modern text-book of photochemistry is no easy one. To keep the volume within reasonable confines is almost as difficult a problem, since the limits to which the author must work are not readily defined. If the author does not presuppose it, a considerable discussion must be devoted to physical principles, especially on the spectroscopic side. Again, photochemistry now reaches far into biology, and the question arises as to whether such a topic should be included in a book mainly compiled for use by physical chemists. Another subject with which it is indissolubly linked is reaction kinetics, for it is difficult to dissociate photochemistry from kinetics, having regard to the fact that there are scarcely any simple photo reactions in the sense that the primary process represents the chemistry of the whole reaction. It is not going too far to say that a large part of photochemistry is now a branch of general reaction kinetics.

In this volume Prof. Rollefson and Dr. Burton have steered a careful middle course. They open with three chapters giving a sufficient account of spectroscopy, yet not enough to frighten off the reader who is concerned only with the more purely chemical aspects of photo-reactions. Similarly, the chapter on reaction kinetics leads the reader without difficulty into the more detailed discussions in the later parts of the book. Then follow the chapters forming the substantial fraction of the book. Nowadays the arrangement is largely a matter of personal choice, for there is no sufficiently rigid framework within which can be fitted the descriptions of the individual types of reaction. The simplest photo-reaction is probably that occurring in alkali halide crystals. Here recent work has added a new and important chapter to photochemistry. Then follow chapters on the photolysis of inorganic compounds, organic molecules, molecular rearrangements, photosensitization and typical chain reactions—all in the gas phase. In these chapters much of the older material is eliminated and only the more recent papers discussed. This is region of great difficulty since there are many reactions to be discussed, but each gets its due quota of space. Even in 200 pages only superficial discussion of any one may be given. It would have been a better plan to have discussed thoroughly and completely a few well-known examples at the expense of the omission of less well-investigated systems. The adoption of a more critical attitude would have done photochemistry no disservice. The specialist would welcome such discussion even though he might not agree with the conclusions. The beginner would be made to realize that the subject is more difficult than he is led to suppose.

The last four chapters of the book deal with topics which are only now in an early stage of development. Addition reactions, the oxidation of aldehydes, polymerization reactions in liquids and heterogeneous photo-reactions are all fairly extensive fields of research in which there is much to be done before a really coherent account may be put in a text-book. A very useful practical appendix completes the volume.

Here then is a book which allows anyone with no specialist knowledge easy access to photochemistry. Those who wish to find what is known about an individual reaction will discover the required information. Those who are already familiar with the subject will find much food for further thought and experiment. H. W. Melville.

PEACE-MAKING AFTER WAR[*]

By The Right Hon. Lord Eustace Percy, P.C.

I AM to discourse on peace-making, but this does not mean that I am going to formulate what are generally called 'peace terms'. On the contrary, I must begin by a warning against programmes of that kind. Peace-making is a process, not an act. It is a process which has been interrupted by war and must be resumed after the so-called 'treaty of peace' is concluded. For such a treaty can do little more than record the desire of the parties to adjust their interests and their ideals in future by peaceful, rather than by warlike, means. The adjustment itself must occupy years. The peace terms may hinder it, if they inflict serious injury, moral or material, on one party; but they cannot do much to further it. The attempt to take advantage of war-weariness, or of a peace congress representing a number of nations, in order to formulate far-reaching safeguards for future peace, has seldom, if ever, been successful.

It follows that the first condition of successful peace-making is that the statesman who attempts it should be left doubly free. He should be left free by his own people from precise pledges as to the contents of the peace treaty; he should be left free by the peace treaty from hampering commitments as to his future policy. He must have behind him the public opinion of his people; but it must be an opinion about the contribution which his people should make to peace, rather than about the kind of peace they would like to have. In peace, as in war, the 'wishing-well' temper of mind is useless. In war, a will to victory is a determination to keep armies in the field, not the dream of seeing them march into the enemy's capital. Peace-making requires a no less continuous effort, no less readiness both to sacrifice immediate advantages and to forgo ultimate dreams. The only sound purpose of discussions about peace-making in time of war is to form a public opinion of this kind, by indicating what are the real causes of the particular war and what, consequently, are the sacrifices which peace-making may demand.

The historian's first, and most obvious, contribution to such a discussion is to remind men of the facts of yesterday, which are in large measure the facts of to-day and to-morrow. From the historian's point of view, the chief evil of war or revolution is not so much its crude immediate effect in human misery as its tendency to produce in the human mind an illusion of emancipation from the quite recent past. Of course, war does change facts; it may kill an old institution, for example, and stimulate a new movement. But, broadly speaking, it kills only what is already decayed, and stimulates only what is already alive. There is no release from the past; the facts of 1942 will not be materially different from the facts of 1938.

What may, we hope, be different in 1942 is our power of understanding what the facts really are; and for this we need to be reminded of a remoter past. In this lies the historian's second, and most important, contribution to the discussions of the hour. The point I chiefly want to make, and to illustrate, is the importance of reckoning our present position in the world's history by reference to a past remote enough to dwarf our contemporary assumptions into their true proportions, and to prepare us for the unexpected forms in which history repeats itself over long periods. If there is anything more dangerous than the illusion of emancipation from the *facts* of the immediate past, it is the tendency to attribute eternal validity to the *ideas* of the last century or two—to measure the whole 'march of mankind' by the eighteenth-century standard of 'enlightenment' and the nineteenth-century standard of 'utility'. It is, no doubt, comforting to compare modern knowledge with that of Aristotle or Seneca or Aquinas; it is not so comforting to reflect that an increase in knowledge may mean only an increase in crude power, that it may fit us only to tutor more ambitious conquerors than Alexander, to advise worse tyrants than Nero, and to herald a more complete collapse of civilization than that which overtook Papacy and Empire in the fourteenth century.

Let me then try to suggest another possible view of European history in relation to present problems.

A dweller on the Roman Wall may, perhaps, be forgiven if he takes as his starting-point the death of the Emperor Hadrian in the year 138. The Rhine-Danube frontier of the Roman Empire, as he left it, has become to-day almost the frontier of Christian civilization—pushed back in the west on the middle Rhine and between the Rhine and the Upper Danube, pushed forward a little in the east between the Danube and the Theiss, but only seriously breached at its centre in Austria. It was there that, twenty-three years after Hadrian's death, the Marcomanni first broke through to the Adriatic; it was there that, exactly eighteen hundred years after his death, another Germanic invasion carried paganism south from the Danube to the Drave. This threatened frontier is to-day the frontier of the British, as it was of the Roman Empire, as the gathering on it of distant armies has reminded us. It would be fanciful to press the analogy, and tedious to qualify it; but it may serve as a point of departure.

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[*] From the Friday evening discourse delivered at the Royal Institution on March 1.

During all these eighteen hundred years, the history of Western civilization has been the history of folk wanderings. For the first nine hundred, down to the establishment, in the second half of the eleventh century, of Norman rule in England and Sicily, of Seljuk rule in Asia Minor, and of Teutonic colonization among the Slavs on the eastern marches of Germany, the sequence of migratory conquest and settlement was almost unbroken. There was an interval of some two hundred and fifty years between the last Teutonic and the first Scandinavian waves of conquest, between the end of the sixth century, when the Lombard Kingdom had been established in Italy, and the middle of the ninth, when the Danes invaded England and the Varangars threatened Constantinople. But midway in that interval the high tide of Arab conquest almost reached the Bosphorus and the Loire, and the age of Charlemagne was but a 'gap between two lightnings'.

The first real interval of consolidation came at the end of the eleventh century. It, too, lasted for about two hundred and fifty years, from the First Crusade to the first Ottoman landing on Gallipoli in 1356. Again, it was broken midway by the Tartar raids; the frontiers of Christian civilization were still hotly contested in Spain, North Africa and Palestine; internally the old Teutonic and Scandinavian tradition of the 'southward thrust' took a new political form in the two great struggles for ascendancy, between Empire and Papacy in Italy and between Plantagenet and Capetian in France. But this troubled interval, especially the thirteenth century, did mark the consolidation of the new peoples of Europe into one society with its own distinctive culture, a single *Kulturgebiet*; it did give freedom of movement, within that society, to the cleric, the merchant, the craftsman and the scholar; it did give opportunity to the rising cities of Italy and Germany to translate old migratory instincts into terms of international commerce. By the end of the period, Genoese ships had attempted the circumnavigation of Africa and a Genoese trading station had been established in South China; population had begun once more to outgrow the resources of medieval agriculture; and, now that the safety valve of the Crusades and the Moorish wars was closed, and Papacy and Empire had fought each other to a standstill, the fighting class was looking for new opportunities of adventure.

The next one hundred and seventy-three years were perhaps the darkest of European history. The resumption of migration was postponed by the Black Death, which nearly halved the population of the Continent. Simultaneously, Europe became the victim, instead of the agent, of a new migratory conquest. Between 1356 and 1529 the Ottoman invasion crept, in successive waves, to its high-water mark beneath the walls of Vienna. The last, and most destructive, decade of its advance was the decade which saw also the first circumnavigation of the globe, the Spanish conquest of Mexico, and the discovery of Peru.

From that moment, for four hundred years, until in 1929 a general economic collapse seemed to have finally closed the New World to European migration, the history of Western civilization has been a history of colonization and trade expansion —of a gradual advance westward to the Pacific, southward over Africa and Australasia, and eastward to India and China. Though that movement reached its culmination with the rapid growth of European population in the nineteenth century, it was already well launched by the middle of the seventeenth. Of the total increase of the English stock between 1600 and 1700, one fifth were probably settled on the Atlantic coast of America by the latter date. What does mark the nineteenth century is that it was then that Europe generally first awoke to what had already been the real trend of Western civilization for two centuries. Is it far from the truth to say that the only lasting effect of all the internal wars of Europe from 1618 to 1815 was to keep down the stock which would otherwise have migrated, to ruin the industries which would otherwise have nourished that migration, and to leave to England and Holland the opportunities of American and Asiatic settlement and trade? Alone among all these wars, the long frontier struggle in the east with the Ottoman Empire was fought for a lasting issue.

If this has been the character of the wars of Europe, what has been the character of its peace-making? If one had to give an answer for the whole eighteen hundred years in one rough formula, one would say, I think, the reconciliation of land hunger with culture. That formula does fit, almost exactly, the first nine hundred years. During most of this period, peace-making was largely in the hands of the Christian Church, as the guardian of a faith and a way of life, and as the successor of the Cæsars. To her, territory was a trifle, as culture was, perhaps, a trifle to the barbarian invader; and her peace-making could therefore be a real bargain—the bargain that Walter Scott put in the mouth of Count Witikind:

> "Give me broad lands on the Wear and the Tyne,
> My faith I will leave and I'll cleave unto thine".

That was the basis of the bargain between Pope and Emperor, and it broke down only when, eventually, the two sides of the bargain lost their contrast—when faith became institutionalized by Hildebrand into an *imperium in imperio*, and when, under the feudal system, the Emperor's authority over the broad lands of Europe was reduced to an indistinct overlordship. The resulting conflict of like with like—of two non-territorial universals—admitted of no compromise ; by the end of the thirteenth century it had destroyed both contestants.

During the fourteenth and fifteenth centuries Europe moved slowly towards a new idea : that civilized society is not a single cultural unit within which its members possess territorial rights, but is composed of a number of territorial units, each asserting its own culture. For two centuries the nature of the new territorial units remained in doubt. The Italian city struggled to assert its economic culture against its fellow cities ; the French and English monarchies their new conception of territorial sovereignty and 'civil dominion' ; the Swiss and the Hussites of Bohemia (with very different fortunes) their ideal of democratic independence. It was not until the new sects of the Reformation were forced to seek protectors powerful enough to save them from both persecution and from disintegration that the territorial sovereigns won. The principle *cujus regio, ejus religio* finally identified culture with large territorial units—but, before that principle was fully established, there had been a last attempt to recreate the wider cultural society of the Middle Ages. The empire of Charles V, combining, in the last two years of his rule, the main bulk of Europe with the new colonies of the Spanish Main, had an unequalled opportunity of uniting the whole civilized world in the enjoyment of unimagined natural resources, unprecedented freedom of movement, and the common heritage of the Renaissance—subject only to the compromise of toleration for differing forms of Christian worship. That opportunity was lost in a blind striving after institutional uniformity, and the tragic waste of that futile struggle left the territorial Culture State in undisputed possession of the field.

Since then, for nearly four hundred years, territorial frontiers have remained the staple issue of both war and peacemaking. The Culture State has long outlasted the assumption which originated it : that one State could accommodate within its frontiers only one form of religion. As toleration has taken the place of religious uniformity, the State has substituted new uniformities of its own. In the last hundred years, the consciousness of nationality, the progress of social reform and the growth of industry have combined to multiply the points at which the authority of law and the claims of freedom may conflict and can be reconciled only by like-mindedness between Government and people. So universal has become the identification of culture with nationality, and of nationality with territorial sovereignty, that Britain's sanguine attempt, after the War of 1914–18, to establish a 'Jewish national home' in Palestine, which should be a culture and not a sovereignty, has ended, for the moment, in a despairing proposal for territorial partition.

Until the very end of these four hundred years, however, the organization of the Culture State offered little obstacle to the free movement of the European peoples. The European Culture States, with their high birth-rates, their racial minorities and their political controversies, were glad enough to see their potential unemployed and their potential rebels become citizens of the United States, the British Empire or Brazil. These new overseas nations, on their side, still unhardened to their function as Culture States, were glad enough to give these immigrants work and the opportunity of wealth, in return for no more than a formal salute to the Stars and Stripes or the National Anthem. So the Count Witikind formula was revived as a bargain between the receiving State and the individual, and might, with a little more imagination, have been translated, in the post-War distresses of twenty years ago, into bargains between Governments. Instead of this, the bargain began to break down, much as it had broken down in the Middle Ages. Already, towards the end of the nineteenth century, the German Empire had begun to discourage emigration, and the last twenty years have seen a hardening of European cultural nationalism into that kind of cultural imperialism which demands that the national flag shall follow the emigrant, carrying with it both national culture and national territorial sovereignty. At the same time, the States of the New World began to adopt, not only the policy of deliberate 'assimilation', but also the policy of restricted immigration in the interests of their economic culture ; and, as their economic culture began increasingly to break down, restriction has hardened into prohibition. Cultural nationalism has frozen the peoples of the civilized world into something approaching immobility.

Let us understand clearly what this means. We live in a world of cultural nationalism ; but we have reached a point in the world's history where such nationalism can no longer offer any basis for a lasting European peace, because it can no longer offer freedom of movement to the European peoples. Demands for 'colonies' on the basis of sovereignty can only end, like the irreconcilable claims of Papacy and Empire in the thirteenth century, in the mutual destruction of the claimants and in a period of chaos which will last until some new Renaissance and Reformation bring us a change of mind. *That* is our position in the world's history. Migration is as necessary to-day to the peoples of Europe as it has been at every stage of European history, save when the European stock has been depleted by pestilence and internecine war. The falling birth- and death-rates of northern and western Europe do not materially affect that need; for, while they diminish the number of those who are too young, and increase the number of those who are too old, to work, they leave almost unaltered the proportion of able-bodied producers to dependent consumers. For example, if the present trend of population in Great Britain continues, the age group 20–59, which now constitutes nearly 57 per cent of the total population, will still constitute 55 per cent in 1985. On the other hand, the need for a constant redistribution of population between industrial and primary-producing countries is greater to-day than ever before, by reason of the over-specialization of these two types of economic units.

But the time is utterly and for ever past when the flag can follow the migrant. If he retains his culture, it must be by virtue of its affinity to the general culture of the country to which he migrates. That truth is obvious to the Briton, but it is so far from obvious to the National Socialist and the Fascist that they have staked their all on a policy of cultural nationalism which can lead nowhere but to blind and fruitless war. Until that mood gives place to a sense of reality, and until the real need for freedom of movement can be met by international agreement, Europe will remain in a state of dangerous unrest, and it will be more important that her future frontiers should be strategically defensible than that they should conform exactly to racial or linguistic boundaries.

Though, for the sake of simplicity, I have spoken of migration, it is important to remember that this is an over-simplification. Over the last six hundred years at least, the rise of international commerce has offered a partial alternative to migration, which did not exist in earlier ages; and when, in the nineteenth century, international commerce took increasingly the form of capital exports from Europe for overseas development, it powerfully nourished migration. The overseas assets thus created were European assets, shared by all European nations, even when they were owned principally by a single nation. English investments in the Argentine promoted the migration to that country of harvest labourers from Italy, and so on. But here, too, our economic culture has been frozen into immobility during the last twenty years. Interest on English capital assets in primary-producing countries, brought to England and distributed by taxation, has still relieved the distresses of unemployed Englishmen who could not seek employment by emigration; but it has not been transferable to other nations by the old processes of re-lending and circular trade. In these circumstances, the concentration of such assets in the hands of English investors has had much the same effect on Europe as the unequal distribution of her population in relation to her natural resources. It has damaged the agricultural economy of England and has starved the industrial economy of Central Europe. Under such extraordinary conditions, the direct conversion of sterling debt in Canada, South America and Australasia into mark or lira debt would have been a rational policy. Unfortunately, an international capital levy of this kind was too simple an idea for those who still use the political and economic language of the last two centuries, who still assume that territory is the only asset that one nation can cede to another, and who still think of economic relations in terms of the circuitous self-adjustments of nineteenth century trade and banking.

It is easier for the historian to suggest analogies than to draw conclusions, but the conclusion of this survey is surely plain.

Peace can no longer be made by bartering territories or adjusting tariffs. The Culture State has run its course. It has worked itself out through all its phases—religious, political, linguistic, racial and economic—and it is now becoming that worst of all human things: a conservative anarchy. The problem of peace-making is how to destroy it peacefully; for if it is not destroyed by peace it will be destroyed by war, by the exhaustion of drawn battle or by successful conquest. If by conquest, it will be a barbarian conquest; the Culture State has created no Hellenism, even if it were to produce an Alexander. It has created, instead, the international culture of Marxism—a culture civilized in its origins but barbaric in its effects, whether it take the form of communism or of national socialism.

But it has created one other thing. It has created a British Commonwealth of Nations, now intimately allied with a French Empire, closely related by political and religious tradition to the five small nations of Scandinavia and the Low Countries, and occupying an extraordinary position in the Middle East. This great political partnership possesses vast economic resources which in the nineteenth century promoted the prosperity of all nations and can now be placed more deliberately at their service. Its chief partners have acquired a high degree of technical skill in the handling of these resources; above all, in their exercise of both political and economic power, they acknowledge, dimly no doubt but genuinely, certain standards of moral duty, derived from a common faith and a common way of life. The wheel of history has not turned full-circle—perhaps it never does ; but it has brought back to us something like the same opportunity as was offered four hundred years ago to the empire of Charles V, the opportunity of embracing diverse territorial sovereignties and races, diverse religious and political creeds, in a wider community, where all men can, at least, find a growing freedom of access both to spiritual and to material wealth. That opportunity may, all too easily, be lost once more—lost in the particularist selfishness of the Culture State or in a blind striving again after the institutional uniformities of a League of Nations or a Federal Union. But if it is lost, we shall be more guilty than Charles V or Philip II, for now the swing of the wheel is with us. It is moving away from, not towards, the Culture State ; it is moving towards, not away from, the greater Culture Society.

Our success or failure will depend mainly on the shrewdness with which we judge what really matters in civilization—what is unimportant enough to be surrendered, and what is valuable enough to be purchased. The civilized man always gets the best of his bargains, not because he has the greater power of compulsion or persuasion, but because he has outgrown his taste for toys and does not mind parting with them—whether he is the trader bartering glass beads for rubber, or the medieval churchman granting land in exchange for repentance. Our danger is that so many trifles have still a superstitious value to one section or other of our democratic electorates : to the nationalist, mere territory ; to the capitalist, his overseas investments ; to the trade unionist, his control of the labour market by restriction of apprenticeship and prohibition of immigration. After the War such problems cannot, of course, be solved by an abrupt abolition of controls and an unconsidered return to freedom. In many of the most important spheres of economic policy, freedom is, indeed, meaningless ; free access to raw materials may mean only freedom to covet them if the purchaser cannot find enough foreign exchange to buy them in sufficient quantities. Nationally, there may be legitimate differences of opinion as to the scope and merits of economic planning ; but internationally we have already a misplanned economy, which must be deliberately replanned if it is not to lapse into chaos. The question for us is whether, in approaching this task, labour and capital in all the democracies of the British Commonwealth can so free themselves from old vested superstitions as to give the necessary discretion for replanning, and the necessary mandate for mutual help and toleration, to international bodies.

That, at least, is one of the two questions that we have to prepare ourselves now to answer—now, above all, when our old toys look so small in the setting of life and death. The other is a greater question still, but I can do no more than mention it. It is the other side of the peace bargain. Having decided what is unimportant enough to be surrendered, what is it that is valuable enough to be purchased at this price ? For the sacrifice will be real, even though it will be mainly a sacrifice of prejudices. What are we to ask in exchange ?

Simply, I think, the recognition of one fact, which we ourselves have almost ceased consciously to recognize. All European civilization for sixteen hundred years has been based on one fundamental assumption : that State law must conform to moral standards which it cannot itself originate. These standards are the measure both of the powers of government and of the duties of citizenship. They are so absolute that their authority has been most accurately described in terms of revelation. But it is of the essence of this conception of civilization that these absolute standards are primarily standards, not for the State, but for the individual. Absolute as they are, every application of them to organized social action involves some compromise, and this debatable land of compromise has been, throughout European history, the scene of all the conflicts and entanglements of Church and State. On this paradox the whole fabric of our civilization rests. Democracy, in the only real sense of that word, is simply the extreme assertion of it—the claim that any exercise of political power must be measured by the individual citizen's sense of right and wrong, even though that measure must always be, to some extent, incompatible with the most efficient exercise of such power. Every effort to evolve a special political morality on the basis of 'reason of State', 'natural law', the 'rights of man' or the rights of nations, has ended in disaster, as it is ending in disaster to-day.

In other words, every conception of government ever formed by Europeans, but above all the conception of democracy, assumes the social recognition of a personal religion, and is meaningless without that assumption. To convert that assumption into the conscious and deliberate assertion of a faith is the other, and greater, half of peace-making. If we are to make peace by merging the Culture State in a wider union, the only possible name for that union is Christendom, and its success or failure will depend on its convinced acceptance of the essential implications of that name.

WORK OF THE MEDICAL RESEARCH COUNCIL

THE recently issued report of the Medical Research Council for the year October 1, 1938–September 30, 1939*, covers a period of some difficulty owing to the disturbed condition of world politics, culminating in the outbreak of war. Nevertheless, a perusal of the report suggests that the progress of the research work pursued under the Council suffered little, if at all, from the state of war expectancy, except for some readjustments towards the close of the Council's year.

With regard to special war emergency services, the Council undertook the organization and supply of antitoxins, in particular tetanus and gas-gangrene antitoxins, that might be required for war casualties, and sera and vaccines that might be needed in dealing with outbreaks of epidemic disease. The organization of an emergency laboratory service and of depots in the Home Counties for the collection, storage and supply of blood for transfusion purposes was also undertaken, and the Council frequently advised many Government departments which sought its assistance.

Nutrition in time of war, both as affecting the population as a whole under conditions of rationing, and the armed forces in respect of the great use of tinned foodstuffs in Service rations, were also the subject of investigation by the Council's staff. Government departments sought the assistance of the Council and of its Industrial Health Research Board on problems of industrial health, particularly in the production of war material, and special war problems are in course of investigation, such as shock occurring after serious wounds, sepsis complicating war wounds and physiological problems of aviation.

Passing to investigations on more general medical problems, a Committee on Preventive Medicine has studied methods of immunization against diseases such as diphtheria and whooping-cough with the view of evaluating their efficiency and determining the best technique, and has inquired into the problem of cross-infection in hospital wards. The causes of the high mortality rates due to broncho-pneumonia, to enteritis in children, and to respiratory diseases during winter have also been investigated.

The chemistry of brain reactions has been the subject of much research, and one of the facts established is the key position held by glucose as the main fuel of nerve tissue. It is also well established that substances normally present in the body perform specific functions in relation to the nervous system. In this connexion, Sir Charles Martin, Dr. Harriette Chick and their colleagues, working at Cambridge, have shown that when pigs are reared on a diet deficient in vitamin B_6 they suffer from epileptic fits similar to those occurring in human epilepsy, and that when this vitamin is then added to the diet the fits cease. Prof. R. A. Peters and his colleagues at Oxford have likewise shown that when vitamin B_1 is deficient in the diet, both man and animals develop characteristic abnormalities of the nervous system. It was shown that, in the absence of this vitamin, the brain cells cannot make proper use of glucose as a food.

At the National Institute for Medical Research, Hampstead and Mill Hill, Dr. Stuart-Harris, Dr. Andrewes and Dr. Wilson Smith have conducted studies upon influenza. An epidemic occurred in the early part of 1939 which clinically resembled influenza, and attempts were made to isolate the influenza virus, which has a characteristic property in being transmissible to ferrets. Even with material from typical cases, all attempts to transmit a virus infection to ferrets failed, and only seven throat washings of patients, out of fifty-nine tested, yielded virus infective for ferrets. The outbreak, as a whole, appears to have been one in which the known influenza virus played a subordinate part, suggesting that other virus strains are capable of causing influenza-like attacks. Drs. Andrewes and Wilson Smith have also continued their experimental inquiry into the factors influencing the immunizing effect of the influenza vaccine.

The relation between human leprosy and rat leprosy was the subject of an interesting research by the late Sir Patrick Laidlaw. The rat disease, caused by an organism very similar to the human leprosy bacillus, is readily transmitted from rat to rat, but there is only one record of the successful transmission of human leprosy to the rat. Syrian hamsters, found by Adler of Jerusalem to be susceptible to infection with the human leprosy bacillus, were inoculated with human leprosy material, and one of the animals developed an infection with typical bacilli. With this material Sir Patrick Laidlaw found it easy to transmit infection not only to hamsters but also to white rats. A critical investigation by Sir Patrick suggested that the original material was derived from a case of human infection with the rat organism and not with the organism of human leprosy. The suggestion is made that human leprosy in the past may have arisen from the rat disease, the bacilli afterwards losing their infectivity for the rat with adaptation to the human tissues.

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* Report of the Medical Research Council for the Year 1938–1939. (H.M. Stationery Office, 1940.) 3s. net.

Work on biological standards, under the direction of Dr. Hartley, is also conducted at the National Institute, and various standards already established are maintained there. A British standard for a gas-gangrene antitoxin (*histolyticus*) has now been made available, and the British standard for diphtheria antitoxin has been placed on regular issue. Much work has also been done on the standardization of tuberculin, various other antitoxins, vitamins and insulin. The work of producing, standardizing and distributing bacterial suspensions and sera for diagnostic purposes has been continued at the Standards Laboratory, Oxford.

The work of clinical research units, of external staffs, wholly or partly financed by the Council, and of individual research workers receiving grants, are summarized in the report, and many valuable contributions have been made to medical knowledge.

It is the intention to move the National Institute at Hampstead to Mill Hill, in association with the Farm Laboratories there, but this has been delayed by the war emergency. Some of the ancillary buildings are, however, ready for occupation, and the shell of the main building is nearing completion.

OBITUARIES

Prof. J. H. Michell, F.R.S.

THE death on February 3 of Prof. J. H. Michell, at the age of seventy-six, is a severe loss to Australia, and the great value of his work both as mathematician and teacher cannot be easily overestimated. His modesty was such that proper appreciation of his real worth was often confined to the fortunate few who were in close contact with him, either through his undergraduate lectures or some research problem.

After an early education in Melbourne, Michell proceeded to Cambridge, where his performance at the Mathematical Tripos and afterwards led to his early election as a fellow of Trinity College. Here he devoted himself to research in elasticity and hydrodynamics, and a remarkable number of important papers in both subjects resulted. He was largely responsible for the introduction of stress equations of equilibrium of an elastic solid which did not involve explicit introduction of the displacement-equations and provided a formal solution of the equations for an isotropic solid with a plane face under given surface tractions. The important theory of that type of deformation known as dislocation was first developed by Michell and he was also one of the first to make use of inversion in solving problems of plane strain and the bending of plates. His work in elasticity included very valuable discussions of the general theory of bending of beams and plates under various loads, besides the detailed solution of a number of special problems such as the elastic equilibrium of conical bodies, the calculation of strains due to concentrated loads, the deformation of naturally curved rods, etc. On the dynamical side of the subject Michell was responsible for the theory of the vibrations of a helical rod and of a circular ring. Perhaps his most interesting contribution to hydrodynamics is the theory of the 'highest' wave in water, but he also published work on discontinuous fluid motion and on wave resistance to ships.

As a just recognition of this excellent work, Michell was elected a fellow of the Royal Society in 1902. A few years later he was appointed lecturer in mathematics in the University of Melbourne and began a long career of devotion to the teaching of the subject. In 1923 he was appointed professor of mathematics and his influence became still more pronounced. To his honours students, among whom I had the privilege to be numbered, Michell was the very personification of mathematical erudition. An hour's lecture by him was an intellectual treat and a whole course of lectures something to look forward to with keen anticipation.

Michell was a great exponent of vector methods and was remarkably facile in their manipulation. He was undoubtedly one of the few mathematicians of his time who really thought in terms of vectors, and he was at pains to educate his students also to think in this way, which is, after all, the natural one for mathematical physics. His influence in spreading a proper appreciation of vector methods represents alone a very important contribution to applied mathematics.

When Michell retired from his chair in 1928 his valuable services were partly retained as honorary research professor. Despite the heavy calls on his time from his academic duties, Michell kept well abreast of all developments in his special subjects and gave several courses of lectures on modern hydrodynamics after his retirement. In 1937 he also published, with his colleague, Mr. M. H. Belz, a treatise on the elements of analysis which is an excellent illustration of the combination of vigour and clarity which characterized his approach to all mathematical problems.

Prof. Michell's modesty and good nature, combined with his remarkable intellectual qualities and willingness to assist in the smoothing-out of difficulties, however trivial, endeared him to his students, all of whom will remember him with affection and admiration.

H. S. W. MASSEY.

Prof. Otto Toeplitz

Prof. Otto Toeplitz, who died on March 15 in Jerusalem, was one of that rare type of scholars who combine with a high standard of specialized research a deep interest in the history of their science and its bearing on general questions. Toeplitz, born at Breslau in 1881, studied mathematics in Breslau and Berlin, became *Privatdozent* at Göttingen in 1907, professor of mathematics at Kiel in 1920 and at Bonn in 1928. In 1935 he was dismissed in consequence of the racial laws of the Nazi Government and went in 1939 to Palestine as scientific adviser to the administration of the Hebrew University.

Toeplitz's mathematical interest was wide and covered all branches of research, but was deeply rooted in algebra. He liked to consider analysis as an algebra of an infinite number of variables, an example of which was given by Hilbert's treatment of integral equations as special cases of linear equations and quadratic forms of infinite sets of variables. Most of his papers deal with problems of this type—infinite matrices and the corresponding bilinear and quadratic forms. His great knowledge and thorough insight in this subject is testified by the article on integral equations in the "Mathematical Encyclopædia" (1928) written in collaboration with E. Hellinger. But Toeplitz's general attitude to mathematics, which he preferred to consider more as an art than as a science, is more clearly visible in his quasi-popular book "Von Zahlen und Figuren", written with Rademacher in 1930, which seems to me a masterpiece of that class of scientific literature which attempts to instruct a wider public in the fundamental ideas of science. It is not easy, but certainly fascinating reading.

In later years Toeplitz's interest went more and more to the history of mathematics. He was a classical scholar able to read Greek texts and he knew his Plato just as well as his Gauss and Weierstrass. Together with Neugebauer and Stenzel, he founded the periodical *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, to which he contributed several articles, chiefly concerned with mathematical ideas in Plato's work.

Toeplitz had no intimate relation to physics, but had nevertheless some indirect influence in its development, the present writer being the link. As a student in Breslau, I was much under the influence of Toeplitz, who was my senior by one year, and though my interest in algebra was not great he insisted on my learning matrix calculus properly and occasionally refreshed my knowledge when we were together again as young teachers in Göttingen. This turned out to be a great advantage to me, first in developing Minkowski's form of relativity, then for the study of vibrations in crystals, which are determined, indeed, by a quadratic form of a (practically) infinite number of variables, but decidedly at the birth of quantum mechanics. When Heisenberg expressed the relations between the quantized amplitudes of atomic vibrations as a kind of symbolic product, the recollection of Toeplitz's instructions enabled me to recognize them as matrix products and (with Jordan) to work out the principal features of quantum mechanics. Though this is only a purely formal step beyond Heisenberg's idea it is perhaps not quite trivial, as shown by the fact that Dirac, in independently developing Heisenberg's idea, invented a new formalism, his q-number calculus, without immediately recognizing the identity of Heisenberg's process with matrix products. Toeplitz himself regarded this unexpected application of his beloved matrices with some suspicion, and rightly from the point of view of the conscientious rigorous mathematician. But he nevertheless continued to give me his advice on special questions.

Toeplitz was devoted to teaching and spent much time and work on it. He was a faithful friend, a man of extreme kindness, but also of strong character and courage. This he amply proved during the hard years of Nazi rule, when he worked with all his force on the problem of saving young non-Aryans from Nazi persecution. M. Born.

Prof. Alexandre Besredka

The recent death of Prof. A. Besredka at the age of seventy deprives France of yet another member of that sadly diminished group of scientific workers whose names are associated with the brilliant and provocative work produced in the early days of the Pasteur Institute. The mention of Besredka's name immediately evokes the whole conception of local as opposed to general or humoral immunity; a conception which has given rise to considerable controversy and thus provoked much fruitful experimental work on the nature of inflammation and the reaction of the body to infection. No memoir would, however, be complete which failed to pay tribute to Besredka's pioneer work in many fields of bacteriology and immunology. During his early days in Paris he was assistant to Metchnikoff. He applied the methods of this master to an illuminating study of the reaction of phagocytes to bacterial exotoxins and endotoxins and to the injection of mineral poisons. Later, Besredka made important contributions to the development of specific immunization against infection, notably in his studies on streptolysin and the use of sensitized vaccines. Anaphylactic shock, which is an abnormal and sometimes disastrous immune response to the injection of foreign protein, also claimed Besredka's attention.

The later years of Besredka's life were devoted to the study of local immunity to infection. He believed that immunity depends upon a state of resistance residing locally in those tissues that are attacked by an infection, and denied the importance of the general immune response of the body and the antibodies circulating in the blood stream. According to Besredka, all attempts at immunization should be applied locally to the susceptible tissue and should aim at modifying the reaction to the noxious agent. His experimental work was mainly confined to infections of the skin, such as anthrax and the staphylococcus, and to intestinal infections, such as typhoid and dysentery. In order to obtain immunity to skin infections Besredka advocated intracutaneous vaccination, inunction or the application of poultices containing the products of bacterial metabolism. It is true that the local resistance of the skin can be raised by these measures, but there is considerable evidence that a similar result can be obtained by non-specific stimulation and that, apart from any question of a general immune response to these procedures, the increased resistance to infection may be due to a non-specific inflammatory response.

In order to combat intestinal infections Besredka advocated the oral administration of bacterial vaccines combined with bile to increase the permeability of the intestinal mucosa. These vaccines have been extensively used in France; but it is difficult to express any final verdict on their efficacy, or to disentangle the local protective effect from the part played by the serum-antibodies which are undoubtedly produced.

If the contribution of a man of science can be measured not only by those discoveries or 'lucky shots' which command universal and immediate acceptance, but also by the skilful presentation of ideas which lead to original experimental work and to the exploration of fresh avenues of approach to intricate problems, then Besredka should be assured of an eminent place in the calendar of bacteriologists.

We regret to announce the following deaths:

Prof. Heinrich Bonhoff, formerly professor of hygiene in the University of Marburg, aged seventy-six

Prof. G. Gallerani, emeritus professor of physiology in the University of Carnerino, aged seventy-six.

Prof. V. I. Sihvonen, professor of chemistry in the University of Helsinki, killed in an air raid on November 30.

NEWS AND VIEWS

Education in the Royal Air Force

IN NATURE of April 6, p. 526, we discussed at some length the urgent case for the provision of adequate educational services by the departments responsible for the Armed Forces. This discussion was mainly in terms of Army organization. The War Office, however, was not alone in showing a lack of regard for educational matters. The general education scheme of the Air Force, which had been carefully built up over many years, seems to have been virtually scrapped overnight on the outbreak of the War—the educational staff dispersed and the premises appropriated to other purposes. Even in the R.A.F. schools of technical training, of which the educational branch has been an essential component, there appears to have been a noticeable educational set-back. This is surely evidence of a regrettable failure to give educational values their proper place in a modern fighting service, manned (as the Air Force conspicuously is) by the finest types of young men the nation possesses. In the treatment meted out by the Air Ministry to its educational staff—the great majority of whom are officers with considerable scientific or technical qualifications—there is further indication of an unfortunate attitude towards education. The civilian status which these educational officers have hitherto had has always made their task an extremely onerous one. For, disregarding the experience of the Navy and the Army—the officers of the education branches of which are commissioned officers on the same footing as executive officers, medical officers and so on—the Air Ministry has continued to impose a civilian status on its educational staff.

Nevertheless, we understand that, before the outbreak of the War, it was accepted by the Air Ministry that whilst this arrangement might be adhered to in peace, it could not work under 'active service' conditions. The education officers were invited to accept commissions in the Royal Air Force Volunteer Reserve, under definite conditions as to pay, rank, promotion, etc. In accordance with this scheme, all educational posts to be retained on the outbreak of war were ranked and education officers were earmarked to fill them. Uniform allowances were granted and all other necessary arrangements were made to enable the scheme to work as smoothly as possible if and when hostilities should begin. In this way, at the beginning of last September, the Air Force education officers assumed their new status. Without warning, however, education officers were informed a few months later that they had been demobilized and must revert to civilian status. That the Air Ministry now realizes something of the invidious position in which this decision has placed its education officers may be inferred from an instruction recently issued that the education officers are to wear uniform as Air Force officers notwithstanding that they have been demobilized and are no longer technically on 'active service'.

The Air Council should see to it that this state of affairs is put right without delay. The reason given for demobilizing the education officers was, we believe, that some (but by no means all) of them were receiving emoluments as Air Force officers greater than those they had received as civilians before the War—though the extent to which this would happen must surely have been known to the Air Ministry when the conditions of the scheme were drawn up. In any event, on any reasonable basis of computation, the sum involved is a mere trifle. Probably it could be eliminated entirely by an adjustment of ranks (and perhaps by other means) acceptable to the education officers, without prejudicing the Air Force status of these officers as has been done by the ill-advised steps recently taken.

The British Association

THE British Association intends, unless unforeseen events intervene, to hold a conference in the University of Reading, by kind permission of the Council of the University, during July 25–27. The general reference will be to science in national and international aspects, and Sir Richard Gregory, president of the Association, will open the conference as chairman. Thereafter there will be meetings in four groups, dealing respectively with international intellectual co-operation; natural resources and national needs; social aspects of human nutrition; and scientific discovery and progressive industry. The preliminary programme for the conference is taking shape, and already a number of distinguished speakers have consented to participate, if circumstances permit, in the various group-discussions. The programme should be ready for issue in the early part of next month. Considerations of finance and the restriction of paper supplies will prohibit its distribution on the usual extensive scale, and any interested persons who do not receive it by the middle of May are requested to ask for it to be sent from the office of the Association at Burlington House, London, W.1.

Admission to the conference will be by tickets, the number of which will be restricted to some seven hundred by the available accommodation. The tickets will be free, but members of the Association will be urged to maintain their subscriptions, and others will be invited either to become members or to contribute by donation to the funds of the Association. Arrangements for the lodging of visitors in the University halls of residence are in hand. The Council of the University will hold an informal evening conversazione for members of the Association and guests.

Siméon Denis Poisson, For.Mem.R.S. (1781-1840)

ON April 25, 1840, the distinguished mathematician Siméon Denis Poisson died at Sceaux at the comparatively early age of fifty-eight. Born at Pithiviers on June 21, 1871, he was the son of a soldier who had served in the Seven Years War, but was brought up by an uncle at Fontainebleau. At the local school he attracted attention by his gift for mathematics, and at the age of seventeen gained admittance to the École Polytechnique, with which he remained connected for practically all the rest of his life. In 1800 he presented to the Paris Academy of Sciences his first mathematical memoir, gaining thereby the interest of Lacroix and Legendre. He was appointed to the chair of analytical mechanics in the École Polytechnique, held the chair of mechanics in the Faculty of Sciences of Paris, was given a seat on Bureau des Longitudes, and became an examiner to both the École Polytechnique and the École d'Artillerie at Metz.

Altogether Poisson wrote more than three hundred memoirs on mathematical, astronomical and physical subjects. His most notable book was his "Traité de Mécanique", published in two volumes in 1811. His work on capillary attraction appeared in 1831 and that on the mathematical theory of heat in 1833. A man of deep convictions, he took no part in political life; finding in mathematical pursuits his work and recreation. When enjoined to spare himself, his reply was "La vie c'est le travail". Among a great number of remarkably able men of science, he stood out as one of the foremost. He was buried in Paris, and a memorial notice was afterwards written by Arago. Napoleon had raised him to the rank of baron, and a few years before his death he was made a peer of France.

Sir Thomas Clouston (1840-1915)

SIR THOMAS SMITH CLOUSTON, a leading Edinburgh psychiatrist, was born on April 22, 1840, at Nist House, Orkney. He was educated first at Aberdeen Grammar School and then at the University of Edinburgh under Goodsir, Syme, Simpson and Laycock. He graduated M.D. in 1861, when he received a gold medal for his thesis on the nervous system of the lobster. After serving four years as assistant physician to the Morningside Asylum, Edinburgh, he was appointed medical superintendent of the Cumberland and Westmorland asylum at Carlisle, where he remained until 1873, when he succeeded Skae as medical superintendent at Morningside and continued in this post until his retirement in 1908. During his period of office he carried out many reforms in the asylum, including rebuilding and the introduction of humane and efficient methods in the treatment of the patients, in addition to making a large number of clinical and pathological observations. Besides being in great demand as a consultant not only in mental disease but also as an expert in forensic medicine, Clouston took an active part in municipal affairs at Edinburgh.

In addition to his principal work entitled "Clinical Lectures on Mental Diseases", which went through six editions between 1883 and 1904 and was for many years a standard text-book, Clouston was the author of "Neuroses of Development", which formed the Morison Lectures for 1890, "Hygiene of Mind" (1906) and "Unsoundness of Mind" (1911). He also contributed an important article on "The Epochal Insanities" to Allbutt's "System of Medicine" (1899). He was the recipient of many honours. In 1911 he was knighted, in 1907 he was made Hon. D.C.L. of Aberdeen and in 1911 of Edinburgh. He was also president of the Medico-Psychological Association of Great Britain and Ireland, of which he was one of the founders, and of the Royal College of Physicians of Edinburgh, and editor of the *Journal of Medical Science*. He died on April 17, 1915.

Factory Hours for Women and Young Persons

A REPORT on hours of employment of women and young persons in factories during the first five months of the War, issued by the Home Office (Cmd. 6182. London : H.M.S.O.), reviews the experience of 1914–18 and the situation at the outbreak of war. It was necessary to agree freely to substantial overtime at the outset so as to meet immediate difficulties and afford time, without holding up urgent supplies, for inquiries into the actual needs of the case. It is also essential, however, to make clear to employers and workpeople that the Factories Act has not gone by the board, and that hours must be regulated, through its machinery, in accordance with a considered policy. The policy was pursued of reviewing the position at individual factories at fairly short intervals, especially during the first months of the War. Orders authorizing extended hours have been made in respect of 2,459 factories, but the hours authorized were often shorter than those applied for, and some applications were refused altogether. Many factory occupiers to whom orders were granted in September and October allowing 57 hours for women have been able to maintain the necessary output with fewer working hours by means of reorganization, and in 239 cases on expiry of the order the occupiers have not desired renewal. A system of two day-shifts has been authorized for 299 factories, but applications to employ women at night have been relatively few and confined almost entirely to armament or allied factories; altogether 57 such orders have been made.

Orders have been made for thirty factories allowing the employment of male young persons more than sixteen years of age in a system of two day- and night-shifts or three eight-hour shifts. In the early weeks of the War many firms, particularly in the engineering industry, and firms engaged in making blinds and other articles urgently required owing to lighting restrictions, were permitted to employ young persons less than sixteen years old up to 47 or 48 hours a week for a short period, rarely longer than two months. Many factory occupiers took such effective measures during the period of the concession that when their orders expired it was unnecessary to employ these young persons beyond the statutory maximum of 44 hours. During the early months of the War, short-term orders permitting the employment of young persons under sixteen up to 48 hours a week were granted to 439 factories, of which 302 were engaged in general engineering and 48 in shipbuilding and marine engineering; 312 of these orders were not renewed, but at the end of the five months under review 133 such orders were in operation. The report states that it is the policy of the Government not to authorize hours which in the light of experience and of scientific investigation are detrimental to health or efficiency.

The Higher School Certificate Examination

THE Higher School Certificate Examination, about which there has recently been an investigation, has two functions: to provide a test of sixth form work and to help in the selection of State and local Education Authority scholars. For the latter purpose the investigators recently appointed to investigate the position of these examinations suggest that they are less suitable than the examinations for open scholarships at the universities, and they also say that the work of non-scholarship candidates is cramped by their association with the others. Yet they found that the examination achieves its double purpose with a fair measure of success and they have not recommended drastic changes. Points for and against two alternative proposals are discussed in a report recently issued (The Higher School Certificate Examination: being the Report of the Panel of Investigators appointed by the Secondary School Examinations Council to enquire into the Eight Approved Higher School Certificate Examinations held in the Summer of 1937. Pp. 93. London: H.M. Stationery Office, 1939. 1*s*. 6*d*. net). The first is that the task of recommending candidates for the award of State scholarships might be handed over to the universities. The second alternative is that the examination might be divided into two parts, one of which would serve for awards of certificates and as a qualifying test for candidates for scholarships, and the other would be entirely competitive. The competition itself would then be conducted by a new central examining body.

The investigators found that the regulations tended both to enrich the larger examining bodies and to impoverish the modern universities, and they have made a simple proposal about the distribution of scholarships which is designed to correct these tendencies. Although the investigators have stated the facts and explained the difficulties clearly, the report seems inconclusive in many respects. It may be no worse for that, yet it is all the more disquieting on nearing the end of the report to find four pages of almost unrelieved condemnation of the science syllabuses and papers, and by implication of the work of the science sixth forms in schools. It is impossible fairly to summarize the statements made on these concisely written pages, but the gist of the matter is that the training of these candidates is too remote from the ordinary affairs of life, that the humanistic and cultural aspects of science generally receive scant attention, and that pupils are not helped to realize how closely scientific discoveries affect human progress or their own life and work. Severe criticism of this sort calls for some response, and the first step towards reform is that those who are engaged in the teaching and examining of science at the Higher School Certificate stage should read this report in a spirit of self-examination. If they do so it is probable that only the unimaginative will award themselves very high marks for their work.

A Pioneer Wireless Station

A MEMORIAL stone in grey Cornish granite has been erected at Alum Bay in the Isle of Wight to mark the position occupied by the first permanent wireless station. The Needles Wireless Telegraph Station holds a place of honour in the history of wireless communication because it was here, in 1897, after a few experiments on Salisbury Plain and other places, that Marconi and the engineers of Marconi's Wireless Telegraph Co. carried out experiments which led to the great achievement of spanning the Atlantic by wireless from Poldhu in 1901. It is claimed that the Needles Station was the first from which a paid marconigram was transmitted on June 3, 1898. The working of this Station was inspected by many prominent people, among them being Lord Tennyson and Lord Kelvin.

The first two paid wireless messages ever dispatched were sent by Lord Kelvin, one to Sir William Preece at the General Post Office on June 3, 1898, and the other to Sir George Stokes, the Cambridge physicist. Lord Kelvin insisted on paying for the messages as an indication of his belief in the possibilities of wireless communication at a time when there was much scepticism. A photograph of the memorial to Marconi on the cliffs of Alum Bay appears in *The Times* of April 11. Four bronze plaques are attached to the memorial; one pays tribute to "Marconi and his collaborators, who carried out from Dec. 6, 1897, to May 26, 1900, a series of experiments which constituted some of the most important phases of their early pioneer work in the development of wireless communication of all kinds". Another records the production of the *Transatlantic Times* in 1899, the first newspaper to be produced at sea, which received information by wireless telegraphy from the Needles Station and printed it in the United States liner *St. Paul.*

Croydon Natural History and Scientific Society

It was on April 6, 1870, that the Croydon Microscopic Club, the forerunner of the Croydon Natural History and Scientific Society, held its inaugural meeting, so the Society is practically a contemporary of NATURE. According to the early records, about a hundred and fifty were present at the meeting, "not all of the savantissime school, it is true—but the majority evincing an earnest desire for the pursuit of science in one of its most interesting branches". Microscopical demonstrations were arranged. The chair was taken by Mr. H. Lee, who reported that the Club included three fellows of the Royal Society, four of the Linnean Society, three of the Geological Society (one of whom was treasurer of the Club), and several members of the Royal Microscopical Society and the Quekett Microscopical Club. Among the speakers were Frank Buckland and Dr. J. S. Bowerbank, F.R.S.

Further meetings were held during 1870. On May 4, J. W. Flower read a paper on the microscopical organisms of the flints. On May 14, the Club formed a party with members of the Quekett to explore the River Wandle for freshwater organisms. The quest was apparently not very successful, but mention is made of the fact that the party managed to obtain adequate refreshment of bacon and eggs, cold beef, tea, etc., at the "Greyhound". On May 28, the Club visited the house and grounds, at Park Hill, of Mr. Flower, who "had provided 2 cart loads of Flints for them to crack" in search of fossil foraminifera, etc.; "the popping of champagne corks was frequently heard above the sound of the geological hammers". On July 30, Mr. H. W. Peek, M.P., entertained the Club, and on November 30, the Club's first soirée, with exhibits, was held in the Public Hall, Croydon. Lest it be thought that undue prominence was given to refreshment of the body rather than the mind, we hasten to add that the Croydon Natural History and Scientific Society, the honorary secretary of which is Capt. B. V. Pring, 33 The Windings, Sanderstead, Surrey, has a distinguished scientific record and normally holds regular meetings twice a month at the Central Library, Croydon.

Bacteriological Warfare

In his inaugural thesis (*Thèse de Paris* 1940, No. 19) on the experimental production of epidemics and epizootics, Dr. Ernest Sarfati states that the question of bacteriological warfare formed the subject of an inquiry in 1923 by a committee of experts including Profs. Bordet of Brussels, Cannon of Harvard, Madsen of Copenhagen, and Pfeiffer of Leipzig. As the result of the inquiry a protocol was issued at Geneva on June 17, 1925, signed by representatives of Germany, the United States, Great Britain, France, Italy, and about forty other nations who undertook that their countries would not take part in bacteriological warfare, the possibility and dangers of which they fully recognized. The experts classified the mode of transmission of bacteria into an enemy country as follows: (1) transportation by aircraft or spies; (2) dispersal of microbic cultures in liquid or solid form; (3) transmission by intermediate hosts such as rats or lice, or the poisoning of projectiles or steel weapons.

The epidemics which theoretically might be produced artificially by these means include malaria, yellow fever, bacillary dysentery, diphtheria, typhus, plague, cholera, enteric fever, Malta fever, tuberculosis, smallpox, influenza, rabies, poliomyelitis and epidemic encephalitis, while the principal epizootics would be glanders, anthrax, foot-and-mouth disease, peri-pneumonia of cattle, and pernicious anæmia of horses. Special circumstances, however, are required to produce epidemics and epizootics, and attempts have repeatedly been made to destroy certain animal species, particularly locusts, without success. Dr. Sarfati comes to the conclusion that while bacteriological warfare is not impossible, it would only succeed in strictly localized areas, in which case the ordinary methods of prophylaxis, including the use of serums and vaccines, would prevent the spread of infection.

Sir Leonard Woolley and Indian Archæological Studies

As anticipated, the reception accorded by Indian opinion to Sir Leonard Woolley's report on the Archæological Department and the state of archæological research in India can only be described as mixed. To a great extent, criticism of its findings has been inspired by umbrage taken that his expert advice should have been invited by the authorities and his verdict received and published, without sufficient regard being paid to the views and opinions of those among the Indians themselves considered competent to judge. Thus it may be considered that it was to some extent a reaction against any attempt on the part of the Government to restrict existing archæological activities in the field that was responsible for the resolution of the Archaic and

Cultural Section of the Indian History Congress, which met at Calcutta on December 15–17, 1939, requesting the Government of India to reconsider the decision to stop further excavation work on account of financial stringency due to the War. A little discrimination in the terms of the resolution would have been indicative of a juster sense of proportion.

A less partial, though not entirely unbiased, view of the situation in archæological studies under official control is taken in an analysis of Sir Leonard Woolley's report, which appears in *Science and Culture* (Calcutta) of January and February 1940. In summarizing his views on the recommendations, the author characterizes the proposals as to museum management, the use of museums for educational purposes, on the training of officers, long-period budgets, choice of sites for excavation, and co-operation between the department and educational institutions as being "very sound", and holds that they should be given immediate effect. At the same time he claims that they are neither new nor original, and suggests that the attacks on the work of the Archæological Survey, excepting those relating to excavation and exploration, are largely unjustified and irrelevant, "probably due to his ignorance of Indian archæology and the methods and practices of service followed by the Government of India". Sir Leonard needs no defender. To refute such charges, as well as much of the criticism to which it is not possible to refer here, it is unnecessary to go outside the pages of the report itself. Such views, however, if general, would not augur well for the future of scientific archæology in India.

The National Physical Laboratory

A NEW Department of Light has been formed at the National Physical Laboratory, to comprise the former Optics Division of the Physics Department and the Photometry Division of the Electricity Department. Mr. T. Smith, head of the Optics Division, has been appointed superintendent of the new department as from April 1, 1940. Dr. E. H. Rayner retired from the post of superintendent of the Electricity Department on March 31, 1940, having attained the normal age limit. He has been succeeded by Mr. R. S. J. Spilsbury, formerly principal scientific officer in the Department.

Recent Earthquake Recordings

ACCORDING to a *Times* message, earth tremors were felt on April 12 on the south coast of Newfoundland at the settlements of François and Rencontre. No damage is reported. The earthquake of November 18, 1929, was felt in the same region though the greatest damage was done to submarine cables somewhat to the south, that is, between lat. 44° N. and 45° N. and between long. 55° W. and 57° W. (NATURE, 124, 859; 1939: 127, 609; 1931).

During March, sixteen earthquakes were registered at Kew Observatory, the greatest number on any one day being two on March 28. Most of the earthquakes registered were small, and there appears to have been a good deal of disturbance due to microseisms. The greatest shock recorded was also on March 28 at 16h. 2m. 4s. G.M.T.

At the Dutch Observatory at De Bilt prominent earthquake shocks were registered on March 27 and 28. The former was apparently not registered at Kew, but the latter may have been the one showing the greatest amplitudes of the month at Kew. Dr. G. van Dyk is of the opinion that the P waves arrived at De Bilt at 16h. 1m. 57s. G.M.T. and the S waves at 16h. 12m. 5s. G.M.T., giving an epicentral distance from De Bilt of approximately 84·2°, assuming a normal depth of focus.

Announcements

THE following recent appointments and promotions in the Colonial Service have recently been made: E. O. Longley, veterinary research officer, Nigeria; A. B. S. Boswell, assistant conservator of forests, conservator of forests, Malaya; W. J. Eggeling, assistant conservator of forests, senior assistant conservator of forests, Uganda.

THE World Congress of Faiths will hold its fifth annual meeting at Bedford College, University of London, during July 5–10. The Marquis of Zetland, Secretary of State for India, will preside at the inaugural meeting at 5 p.m. on July 5. The main theme for the Congress will be "The Common Spiritual Basis for International Order". Further information can be obtained from the Secretary, Mr. Arthur Jackman, Room 336, Abbey House, 2–8 Victoria Street, London, S.W.1.

A MEDICAL building belonging to the Hebrew University has recently been completed in the Garden of Olives in Jerusalem. It will serve as a medical centre for diseases of all kinds, not only for Palestine but also for the rest of the Near East.

OWING to the need for economy in the use of paper, the Council of the Royal Sanitary Institute has decided that after the completion of the present volume in June, the *Journal of the Royal Sanitary Institute* will be issued quarterly instead of monthly.

A CORRESPONDENT has pointed out that the radiographic contrast medium for urography referred to in a paragraph entitled "X-Ray Photography of the Renal System" in NATURE of March 23, p. 459, is the same substance as the German preparation marketed before the War as 'Uroselectan B'. It is being manufactured in Great Britain and sold as 'Pyelectan' by the Glaxo Laboratories, Ltd., and as 'Uropac' by Pharmaceutical Specialities (May and Baker).

ERRATUM.—In NATURE of April 6, p. 529, col. 1, line 15, the reference to the paper by Prof. E. Schrödinger should read "*Preuss. Akad.*, 1930" instead of "*Preuss. Akad.*, 1936".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Notes on points in some of this week's letters appear on p. 630. Correspondents are invited to attach similar summaries to their communications.

The Atmospheric Layer from which the Yellow Line in Twilight originates

Through measurements at the Pic-du-Midi, Garrigue[1] found that the average intensity of the yellow line in the night sky 10° above the horizon is about 2·8 times that at the zenith, from which Cabannes, Dufay and Gauzit[2] found the altitude of the layer emitting the yellow line to be about 130 km.

Bernard observed at Tromsoe the time at which the intensity of the yellow line *in twilight* suddenly drops. Assuming the excitation to be restricted to a region exposed to ordinary sunlight, and that, therefore, the disappearance of the yellow line takes place when the shadow of the solid earth exceeds a certain height (H_B), Bernard concludes[3] that the emission of the yellow twilight line is restricted to a layer below 60 km.

Bernard regards this result as in conflict with that of Cabannes, Dufay and Gauzit, which he considers to be based on unreliable data ; but as he is dealing with a different light phenomenon, for which the distribution with altitude of the excitation agency will be different from that of the night sky luminescence, there is not necessarily any conflict between the results.

On the basis of extensive observational material from Oslo, I have been able to show that *the yellow line is also emitted in twilight from a layer situated at the lower part of the auroral region.* By means of a small spectrograph of great light power, we took a series of twilight spectrograms, partly in the zenith and partly in a nearly horizontal direction. If, with Bernard, we assume that the emission of the yellow line is determined by the shadow formed of visible sunlight by the solid earth, then the observations near the horizon would give a greater upper limit (59 km.) of the effective emission layer than the spectra from the zenith (45 km.).

Assuming, however, that the yellow line is excited by some easily absorbed, probably ultra-violet solar radiation, and that the atmosphere below a certain height (H_S) acts as a screen for the effective solar rays, then *this screening height may be found from the condition that the spectra from the zenith and from the near horizon must give the same upper limit* (H_u) *for the emission of the yellow line.*

The observations from Oslo give for the effective screening height $H_S = 55$ km. and for the upper limit of effective excitation $H_u = 115$ km.

It is of interest to notice that the screening height is just above the region of relatively large ozone concentration. The effective height is found to be about the same in the evening and in the morning, showing that there is no noticeable time-lag in the emission process.

These results indicate an extra-terrestrial origin of the sodium from which the yellow line is emitted. It is possible that, in addition to the hydrogen showers previously dealt with[4], showers of sodium coming from the sun may enter the atmosphere. Possibly the hydrogen showers, in connexion with sodium and atmospheric oxygen, may account for the luminous night clouds. Our results regarding the position of the effective sodium layer also enable us to make certain estimates regarding the effective solar radiation. If it is ultra-violet light, it should be found somewhere in the interval 1900–3100 A. The screening limit (H_S) is due to ozone absorption, the maximum of which lies at about $\lambda = 2500$, or near the wave-length ($\lambda = 2412$) corresponding to the ionization potential of the sodium atom.

L. Vegard.

Physical Institute,
Oslo.
March 11.

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[1] Garrigue, *C.R.*, **205**, 591 (1937).

[2] Cabannes, Dufay and Gauzit, *C.R.*, **206**, 1525 (1938) ; Nature, **141**, 1054 (1938) ; *Astro. J.*, **88**, 164 (1938).

[3] Bernard, *C.R.*, **206**, 448, 928 (1938).

[4] Vegard, Nature, **144**, 1089 (1939).

Absorption of the Hydrogen Line 1215·7 A. by Air

In a recent letter[1], S. E. Williams reports measurement of the absorption in air and oxygen of the first line of the Lyman series of hydrogen, Ly_a, at 1215·7 A. This problem is of interest because of the suggestion by Martyn *et al.*[2] that Ly_a radiation from solar eruptive areas may be responsible for radio fade-outs. Williams's result was that a path length of 0·04 cm. of oxygen reduces the intensity of Ly_a by a factor of one half. This represents an absorption coefficient about fifty times as large as that found in a recent determination of mine[3].

Without details of his experimental method, it is difficult to suggest any explanation for this startling disagreement. Since water vapour, carbon dioxide, and most organic vapours have relatively much larger absorption coefficients at this wave-length, small traces of impurities would be sufficient to explain a result that was much too high.

It is more difficult to imagine a source of error which would give too *low* a value for the oxygen absorption. Williams suggests that the absorbing oxygen in my experiment may have been largely dissociated. Ladenburg and Van Voorhis[4] were bothered by dissociation when measuring oxygen absorption in the 1350 A. region. The oxygen in their cell disappeared rather rapidly, probably as a result of the adsorption of atomic oxygen on the cell walls. I was aware of this possible source of error. However, my source was a largely 'atomic' hydrogen discharge, with very low intensity in the spectral region responsible for oxygen dissociation. In addition, observation of the pressure in the absorpton cell during a prolonged run showed that it did not perceptibly decrease. It is therefore felt that no considerable error could have arisen from dissociation, and that the lower value for the absorption coefficient of oxygen, which is in agreement with previous estimates[5], is the more reliable.

It should be pointed out that a law of absorption $\log I_0/I = \mu x + C$ (where I_0/I is the ratio of incident to transmitted intensity, μ the absorption coefficient, x the equivalent path length at N.T.P., and C a constant found by Williams to have a negative value) can scarcely be called 'usual', as stated by Williams. It presumably predicts zero absorption for the range $0 < \mu x < |C|$, and I can find no record of the actual observance of such a phenomenon. Williams refers to Shalow and Steiner[6] as having described a case in which the *absorption coefficient* μ (attributed to O_2–O_2 molecules) varies with the *square* of the pressure p. Reference to their article indicates that they found that $\log I_0/I = ap^2$ (where a is a constant). The usual law of absorption, which can be written as $\log I_0/I = \frac{\mu l p}{76}$ (where μ is the coefficient of absorption, l the *actual* path length, and p the pressure in cm.), then shows that μ is directly proportional to p, not to p^2. They found no evidence of zero absorption over a finite pressure range.

W. M. PRESTON.

Harvard University,
Cambridge, Mass.
March 9.

[1] Williams, S. E., NATURE, **145**, 68 (1940).

[2] Martyn, Munro, Higgs and Williams, NATURE, **140**, 603 (1937).

[3] Preston, W. M., *Phys. Rev.*, **43**, 315 (1939) abstract only; complete report shortly to be published in the *Physical Review*.

[4] Ladenburg and Van Voorhis, *Phys. Rev.*, **43**, 315 (1933).

[5] Chapman and Price, *Rep. Prog. Phys.*, **3**, 58 (1936) quote Hopfield, that a 10 cm. path of oxygen at N.T.P. is neccssary to "completely absorb" Ly_α.

[6] Shalow and Steiner, *Z. Phys.*, **99**, 137 (1936).

Rotational Analysis of the Band Spectrum of Boron Monobromide

THE $^1\pi \rightarrow {}^1\Sigma$ spectrum of the molecule BBr[1] has been photographed in the second order of a 6·5 m. concave grating. The light source was an uncondensed discharge through BBr_3-vapour in a pyrex H-type tube fitted with quartz window and nickel electrodes. The rotational structure of the (0,0)-band at 2950 A. is partially resolved into lines. Measurements in the P-, Q- and R-branches, where lines up to $J \sim 90$ can be observed, make a complete analysis of this band possible. The constants of the BBr-molecule are found to be:

$$\begin{array}{llll|llll} {}^1\Sigma+ : & B''_0 = 0{\cdot}487 & \text{cm.}^{-1} & & {}^1\pi : & B'_0 = 0{\cdot}496 & \text{cm.}^{-1} \\ & D''_0 = -0{\cdot}90\times10^{-6} & ,, & & & D'_0 = -1{\cdot}25\times10^{-6} & ,, \\ & r''_0 = 1{\cdot}890 \text{ A.} & & & & r'_0 = 1{\cdot}875 \text{ A.} & \end{array}$$

Owing to the small difference of the constants B' and B'', the constants D' and D'' determine the form of the branches, which are rather unusual, the Q-branch forming two heads, one at the zero line, the other at $J \sim 100$. The value $B'' = 0{\cdot}487$ of the ground state together with the ground frequency $\omega e'' = 684{\cdot}0$ cm.$^{-1}$ gives for Mecke's bounding constant $k = \omega^2/4B$ the value 240,000 cm.$^{-1}$, confirming very strikingly the value calculated formerly from AlCl data for the group of halides of metals of the third group in the periodic system.

The full paper will appear shortly in *Helv. phys. Acta.*

E. MIESCHER.
E. ROSENTHALER.

Physical Institute,
University of Basle.
March 18.

[1] *Helv. phys. Acta*, **8**, 279 (1935).

A Photographic Method of Studying β-Ray Absorption by $^{32}_{15}$P

IN a previous communication[1], I pointed out the photographic action of artificial radio-elements; as an application of this, it has been possible to study the β-ray absorption of radiophosphorus through aluminium. Radiophosphorus was prepared by irradiating carbon disulphide by means of the neutrons emitted from 900 mgm. radium plus beryllium; its concentration was effected by means of an electric field[2]. The solutions containing $^{32}_{15}$P (20–200 × 10^3 kicks per minute) were evaporated to dryness on a water-bath in leaden vessels 1·5 cm. × 12 cm. × 0·3 cm. In order to establish the absorption curve, a series of aluminium absorption screens of increasing thickness (0·1–1·06 mm. and every 0·1 mm. up to 1 mm.) were placed between a Kodak X-ray film and each of these vessels. The photographs obtained were checked by means of a Zeiss microphotometer.

According to Bothe[3], who studied the blackening of a photographic plate as a function of the β-ray intensity, the photographic density D is proportional to the number of impinging electrons up to $D = 1$. The mass absorption coefficient can be deduced from the logarithmic absorption curve.

On the other hand, the results of measurements with a Geiger-Müller counter show, from 1·5 mm. aluminium onward, an incurvation of the logarithmic absorption curve toward the thickness axis. However, the curve is linear between 0 and 1 mm. aluminium, and it is possible to calculate the mass absorption coefficient μ/ρ.

Microphotometer deductions yield $\mu/\rho = 9{\cdot}27 \pm 0{\cdot}11$, whereas Geiger-Müller counter and electrometer methods give $\mu/\rho = 8{\cdot}55 \pm 0{\cdot}20$ and $\mu/\rho = 8{\cdot}51 \pm 0{\cdot}02$ respectively.

Thus the intensity of β-rays emitted from an artificial radioelement can be determined by a photographic method.

J. GOVAERTS.

Laboratory of Radioactivity,
Institute of Physical Chemistry,
University of Liège.
March 14.

[1] Groven, Ch., Govaerts, J., and Guében, G., NATURE, **141**, 916 (1938).

[2] Govaerts, J., *Bull. Soc. Roy. Sci. Liége*, 121 (1939).

[3] Bothe, W., *Z. Phys.*, **8**, 243 (1922).

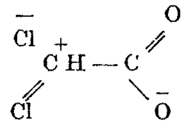
Resonance in the Chloroacetic Acids

IN addition to heat data, internuclear distances, and electric dipole moments, dissociation constants are now being used to determine whether or not possible valence bond structures contribute to the actual state of a molecule[1].

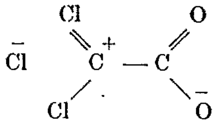
It is suggested that the dissociation constants of the three chloroacetic acids furnish such information. These acids present an interesting problem. The relevant data[2,3] are: CH_3COOH, $K = 1{\cdot}7 \times 10^{-5}$; $CH_2ClCOOH$, $K = 1{\cdot}4 \times 10^{-3}$; $CHCl_2CO\,OH$, $K = 5{\cdot}1 \times 10^{-2}$; CCl_3COOH, $K = 1{\cdot}2$. Now monochloroacetic acid has a dissociation constant about eighty times that of the unsubstituted acid, the reasonable explanation being that the strong dipole $\overset{+}{C} - \overset{-}{Cl}$ ($\mu_{Cl} = 1{\cdot}5\,D$) has been substituted for the weak dipole $\overset{+}{H} - \overset{-}{C}$ ($\mu_H = 0{\cdot}4\,D$). Di- and trisubstitution, however, lead to dissociation constants 3,000 and 100,000 times that of the parent acid.

Let μ_{Cl} be the moment of the C—Cl link in chloroacetic acid. The resultant moment (μ_R) of the two C—Cl links in dichloroacetic acid is $2\mu_{Cl} \cos \theta/2$, and for the three C—Cl links in trichloroacetic acid it is $\mu_{Cl}\,(6 \cos \theta + 3)^{1/2}$, θ being the tetrahedral angle, and neglecting dipole interaction. It is clear that no functional relationship can be traced between μ_R and K, since the μ_R's are all of the same order of magnitude, being in the ratios 1 : 1·2 : 1. It is also probable that dipole interaction reduces the resultant moments of the dichloro and trichloro groups, as shown by the dipole moments of methyl chloride, methylene chloride, and chloroform[4].

Some other factor must thus enter and succeed in strongly enhancing the dissociation constants of the di- and tri-substituted acids. It is suggested that this additional factor is resonance, which preferentially stabilizes the ionic forms. In the mono-substituted acid, the inductive effect of the C—Cl dipole is the enhancing influence, but in the case of the di-substituted compound, four conjugated structures of equal energy of the type



contribute to the actual state of the ion, the energy of resonance effecting stabilization. With trichloroacetic acid, twelve structures of the type



contribute, quantum mechanics leading also to the conclusion that each C—Cl bond length will be equal to and approach the double bond value[5]. Because of the separation of charge, these structures would not be expected to be as stable as the normal structures, but a linear relation does exist between log n and log K for the three chloro acids with $n = 2$, 6, and 14. It may be mentioned that electron diffraction investigations have established the facts[6] that the C—F bond distance in methyl fluoride is 1·42 A., whereas it is 1·36 A. in methylene fluoride, indicating the existence of structures of the type now postulated.

H. O. JENKINS.

35 Grand Avenue,
Ely, Cardiff.
March 1.

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[1] Jenkins, H. O., NATURE, **145**, 149 (1940).

[2] Dippy, J. F. J., *Chem. Rev.*, **25**, 204 (1939).

[3] Cohen, "Organic Chemistry", Part 1, p. 341 (Arnold).

[4] Sutton, L. E., and Brockway, L. O., *J. Amer. Chem. Soc.*, **57**, 473 (1935).

[5] See numerous publications of Linus Pauling.

[6] Brockway, L. O., *J. Phys. Chem.*, **41**, 747 (1937).

History of the Vacuum Flask

SIR WILLIAM BRAGG, in the brief account of his lectures on Dewar's research published in NATURE of March 16, mentions that vacuum vessels were made in the early days by C. E. Muller, who was a German glassblower settled in London. Though this is undoubtedly correct so far as it goes, I think that it may leave the wrong impression that Muller made the first vacuum vessels. Such an impression would be unjust to the memory of Dewar's assistant, R. N. Lennox, who actually made the first vessels. They were pointed out to me by my father a few weeks afterwards, on Lennox's bench as Lennox's work. My father's assistant, George Gordon, who had seen Lennox making them, showed me the method which he had seen Lennox use, making a small cylindrical vessel as a demonstration for me. To make spherical vessels was rather beyond Gordon's skill, and later he got Lennox to show me this. The early vessels used by Dewar for some time were of Lennox's make, and if I am not mistaken, some of them are still preserved at the Royal Institution. I should recognize them without doubt. It is likely that Muller was the first to make such vessels outside the Royal Institution, but I do not think that he had arrived in London when Lennox first made them. I was in the habit of frequenting his shop as soon as I learnt of its existence.

RAYLEIGH.

Terling Place,
Chelmsford.
March 27.

Aurora and Magnetic Storm of March 24-25

THE aurora and great magnetic storm of March 24–25 was followed by a second display and storm of only slightly less intensity on March 29–30. The first storm began 24d. 13h. 45m., and ended abruptly 25d. 13h., the later phase from 5h. being characterized by unusually large and rapid oscillations. This storm was greater than that of the great aurora of January 25, 1938, the range in declination being more than 150′, and in horizontal force more than 750 γ, being beyond the limits of registration in both elements. It was preceded by definite disturbances of moderate intensity from 20h. to 23h. on March 22, and from 20h. 30m. on March 23 to 1h. on March 24, and was followed by a notable disturbance from 20h. on March 25 to 3h. on March 26, the series forming a well-marked sequence at about one day's interval.

The second storm began on March 29 at 16h., and was dying down when the record was taken off the instruments at 10h. on March 30. The range in declination was 127′ and in horizontal force again more than 750 γ, being beyond the limits of registration, but apparently to a less extent than in the previous storm.

This second storm could easily be attributed to the influence of the large sunspot which crossed the central meridian on March 26·3, but it is difficult to assign this spot as the cause of the earlier storm, as in this case, allowing for time of transmission, any emanation from this area would have had to be emitted at a very great angle to the solar radius, which is not easily accounted for.

J. P. Rowland.
(Director).

Stonyhurst College Observatory,
Near Blackburn,
Lancashire.
March 31.

Relativity of Time

In Prof. H. Dingle's article on "The Relativity of Time"[1] and the correspondence that has followed, it is taken for granted that, while the Fitzgerald contraction can be detected experimentally, the slowing up of a moving clock cannot. Prof. J. W. Campbell[2], while disagreeing with Prof. Dingle on other points, is in agreement on this point. This, if it were true, would indicate a surprising lack of symmetry between time and space; but the following considerations show that there is in fact no such lack of symmetry.

The Lorentz transformation relates the space and time measures adopted by two observers in relative motion on the assumption that the observers use *independent* and *indistinguishable* experimental procedures and apparatus. If a stationary observer determines the time by measuring the rest-mass of sand flowing through an hour-glass at rest at the origin, then the moving observer must be assumed to determine the time as the *rest*-mass of sand flowing through an hour-glass, indistinguishable from that used by the stationary observer, and moving with the moving observer's origin.

The slowing down of a moving clock is deduced from the Lorentz transformation on the supposition that the readings of the moving clock could be used by an observer moving with it so as to satisfy the above requirements: in other words, the clock could be used by an observer moving with it without his knowing that it was moving. The predicted slowing down does not, therefore, apply to the moving clock suggested by Prof. Dingle in which the mass of sand flowing through an hour-glass is measured in the *stationary* co-ordinate system; for, if the observer moving with the clock does not know that it is moving, he cannot recognize the stationary co-ordinate system in which the mass is to be measured.

Now consider a uniformly moving clock A that satisfies these conditions, and let B be a stationary clock that is indistinguishable from A. Suppose that the positions of the clocks coincide when the reading of A is t_0. Let light signals be sent out from A when its readings are $t_0 - t_1$ and $t_0 + t_1$, and let these signals reach B when its (that is B's) readings are t_2 and t_3. The slowing up of the moving clock is demonstrated by the inequality $2t_1 < t_3 - t_2$. This experiment is closely analogous with that suggested by Prof. Dingle to detect the Fitzgerald contraction.

F. C. Powell.

Gonville and Caius College,
Cambridge.
March 18.

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[1] Nature, 144, 888 (1939).

[2] Nature, 145, 426 (1940).

I think Dr. Powell's letter is based on a misunderstanding. I did not say that it was impossible to detect experimentally the slowing-down of a moving clock. My point was that whatever slowing-down was detected would not necessarily be in the Fitzgerald ratio unless the clock was an 'ideal' one, and that we could not check the relativity requirement with regard to time measurement by experimenting on actual clocks, because if they did not confirm it, the proper deduction would be simply that they were not ideal. The "lack of symmetry between time and space" thus implied is not at all "surprising". It exists because we can make an 'ideal' measuring rod but not an 'ideal' clock. You cannot, in fact, define the standard unit of length without implying the existence of the measuring instrument—the material bar. The unit of time, on the other hand, cannot be embodied in a material instrument. The best we have, the rotating earth, itself needs slight correction, and experiments on relatively moving earths are, to say the least, difficult. (Incidentally, I wonder if Dr. Powell and Prof. Campbell have considered the case of relatively moving sundials?)

Much confusion is introduced into the subject by multiplying observers. The special theory of relativity can be completely deduced by re-defining length as $l\sqrt{1-v^2/c^2}$ instead of l (where l is the length of a body measured by a relatively stationary rod and v is whatever velocity the body may have in the arbitrary co-ordinate system chosen), and following out the logical implications of the change in all other measurements. This can be done by a single observer, who can choose two co-ordinate systems and compare them. Suppose he has two measuring instruments (say clocks), A and B, one moving with velocity v relatively to the other. He can choose which he pleases to be at rest. If he chooses A, then B is running slow: if he chooses B, then A is running slow. That is how much "objective reality" there is in the slowing-down. If he makes an experiment to see which is "really" running slow, he must make some calculations from his observations to get his result, and the formulæ he must use will depend on his choice of co-ordinate system. They are such that he will always find the "moving" clock, whichever it is, to be running slow, when corrected to the "ideal".

This way of looking at the matter should dispose of the question, which every correspondent has raised, about the measurement of the "moving" mass of sand by the "stationary" observer. A single observer, given the definition of mass (a definition which is not satisfied by "rest-mass", for that is not conserved), has to measure the mass of a body according to that definition, whether it is moving or stationary with respect to himself. If he has to move with it every time, then the mass of a moving body has no meaning, for the whole point of the relativity theory is that there is no absolute, but there is relative, motion. Further, all observers, however they are moving relatively to each other, will obtain the same measurements of similar bodies at rest with respect to themselves. There is no significance in an observer of an object "knowing that it was moving"; what he should have known was that it was moving or not, according to his choice.

Imperial College,
London, S.W.7.
March 27.
HERBERT DINGLE.

Production of Tumours in Mice by Deoxycholic Acid

J. W. COOK[1] pointed out that the sterols and bile acids contain in their molecules condensed carbon-ring systems to which are attached a side-chain in such a position that a new 6-membered ring can be formed so as to give the 1 : 2-benzanthracene ring system without molecular rearrangement or group migration. The bile acids of the higher vertebrates are all mono-, di-, or tri-hydroxy derivatives of cholanic acid, which compound can be obtained *in vitro* from sterols by degradation, and the principal bile acids bear the names of lithocholic acid (3-hydroxy-cholanic acid), deoxycholic acid (3 : 12-dihydroxy-cholanic acid) and cholic acid (3 : 7 : 12-trihydroxy-cholanic acid). J. W. Cook and G. A. D. Haslewood in 1934[2] showed that, in the formation of dehydronorcholene from deoxycholic acid by the procedure of Wieland, such a ring-closure to the 1 : 2-benzanthracene ring system had actually occurred. Dehydronorcholene gave on dehydrogenation the benzanthracene hydrocarbon methylcholanthrene, which was found to be strongly carcinogenic. Afterwards, Fieser and Newman[3] showed that methylcholanthrene could be obtained also from cholic acid, which is the chief acid of human bile, and the parent hydrocarbon cholanthrene was synthesized by J. W. Cook, G. A. D. Haslewood and A. M. Robinson[4] and shown to be carcinogenic.

The discovery that a carcinogenic compound could be obtained from deoxycholic acid led us to test for possible action of this kind the acid itself, which was applied in solution in a mixture of alcohol and benzene to the skin of 20 mice in the ordinary way. An epithelioma at the site of application developed in a single mouse in 776 days. The experiment was repeated upon, in all, 80 mice, of which some lived more than 800 days, but no more tumours were obtained. Afterwards, deoxycholic acid was injected in sesame oil into the right flank of 10 mice of mixed stock, of which 5 lived for more than 6 months. Of these five, three developed at the site of injection spindle-celled tumours of the type usually produced by carcinogenic compounds and were killed on the 351st, 355th, and 367th days. The tumours were regarded as malignant on histological grounds, but did not grow when transplanted into other mice of mixed stock. These mice had received 15 injections containing in all 70 mgm. of deoxycholic acid in 300 days. This is, of course, a large amount, and the time required for the development of tumours is long. However, the experiment was repeated using 10 mice of the strain C_3H which, of eight strains examined by Andervont[5], is placed first in the order of susceptibility to subcutaneous tumours induced by carcinogenic hydrocarbons, and of these mice one has now developed a spindle-celled tumour in 155 days (that is, a period less by 200 days than that required by the stock mice) after receiving a total of 28 mgm. in the course of six injections. These results confirm those of Vittorio Ghiron[6], announced at the Third International Cancer Congress at Atlantic City in September 1939, who says "Desoxycholic acid elicited transplantable subcutaneous fibro-sarcomas in a high proportion of the mice and rats injected. This is believed to be the first experimental production of malignant growths with a compound that exists under some conditions in the human body". We have not found any more detailed publication by Ghiron of his results.

Occasionally, tumours are produced in mice by sesame oil alone (W. U. Gardner, personal communication to Dr. Hieger) but we have obtained negative results with many compounds in this solvent, and we do not think that the incidence of tumours recorded above could be attributed to it. We have no evidence that deoxycholic acid can be converted *in vivo* into methylcholanthrene, but at the same time the slow action and large amount required of the acid, and the superiority of injection over external application, are compatible with conversion into some more active compound. Shear[7] obtained negative results by injection of deoxycholic acid, and cholic acid, *sub cutem* in mice, but a single injection only, in glycerol, was given. We are carrying out further experiments with deoxycholic and cholic acids.

Several other investigations in progress here are concerned with the liver in relation to carcinogenesis. Thus Dr. L. D. Parsons[8] has described the increased flow of bile in some tumour-bearing mice, and the use of bile in preparing cell-free filtrates from tumours; Dr. Hieger has confirmed the discovery of Schabad[9] that some extracts of human livers will produce sarcomas in mice, and is preparing these results for publication; and J. W. Cook[10] has described compounds (2 : 2′-azonaphthalene and its transformation product 2 : 2′-diamino-1 : 1′-dinaphthyl) which have a specific action in producing malignant tumours of the liver.

We are indebted to the British Empire Cancer Campaign for a grant which has supported this work.

J. W. COOK.
E. L. KENNAWAY.
N. M. KENNAWAY.

Chester Beatty Research Institute,
Royal Cancer Hospital (Free),
London, S.W.3. March 31.

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[1] Cook, J. W., and Kennaway, E. L., *Chem. and Ind.*, **10**, 521 (1932).

[2] Cook, J. W., and Haslewood, G. A. D., *J. Chem. Soc.*, 428 (1934).

[3] Fieser, L. F., and Newman, M. S., *J. Amer. Chem. Soc.*, **57**, 961 (1935).

[4] Cook, J. W., Haslewood, G. A. D., and Robinson, A. M., *J. Chem. Soc.*, 667 (1935).

[5] Andervont, H. B., Public Health Reports, **53**, 1647 (1938).

[6] Ghiron, V., Summary of Communications, 3rd International Cancer Congress, p. 116 (1939).

[7] Shear, M. J., *Amer. J. Cancer*, **36**, 211 (1939).

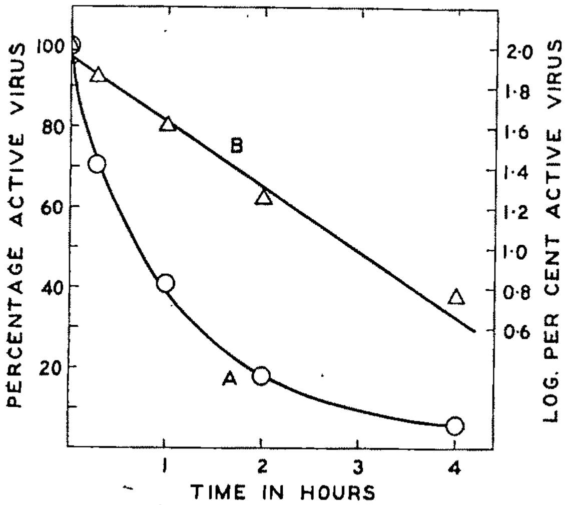
[8] Parsons, L. D., NATURE, **144**, 75 (1939).

[9] Schabad, L., *C.R. Soc. Biol.*, **124**, 213 (1937).

[10] Cook, J. W., NATURE, **145**, 335 (1940).

Some Effects of Salicylate on Plant Viruses

DURING an investigation into the effects of various anions on the precipitation of the paracrystalline solid phase of tobacco mosaic virus nucleoprotein (*Marmor tabaci*, var. *vulgare*, Holmes) from its solution in water, the salicylate ion was found to behave differently from other anions. For each salt there was found a critical concentration at and above which the virus was precipitated from solution in the form of spontaneously birefringent microtactoids or fibres. The white precipitate of virus nucleoprotein



GRAPH ILLUSTRATING THE RATE OF INACTIVATION OF PURE TOBACCO MOSAIC VIRUS BY POTASSIUM SALICYLATE (1·0 *M*.) AT *p*H 7 AND 30° C.

is still fully infective and may be redispersed to give a clear solution by mechanical agitation or dilution as described previously[1]. However, the precipitate produced by solutions of potassium salicylate at concentrations above 0·46*M*. is very different in character from that obtained with other salts. It consists of an insoluble, amorphous, white, granular solid deposit of denatured protein. Mechanical agitation or dilution does not cause re-solution. At the same time the virus loses its infectivity irreversibly. The accompanying graph illustrates the rate of inactivation of a 0·2 per cent solution of the pure virus by 1·0*M*. potassium salicylate at *p*H 7 and 30° C. The straight line nature of curve *B* indicates that the rate of inactivation is logarithmic. The rate of inactivation is greater the greater the concentration of salicylate and is markedly influenced by the temperature. With solutions of salicylate of the order of half molar there is only a partial inactivation, and a steady state appears to be set up after a few hours. At a concentration of 0·1*M*. there is no loss of infectivity, of stream double refraction or solubility after a contact of forty-eight hours. Denaturation, loss of stream double refraction and of infectivity all run parallel.

The virus of tomato spotted wilt (*Lethum Australiense*, var. *typicum*, Holmes) is very much more susceptible to the inactivating action of salicylates. Suspensions of it are rendered inactive in one hour (at *p*H 7 and 30°) by a 0·1*M*. solution of potassium salicylate. In this case cystein was used to arrest oxidative inactivation of both control and test suspensions.

Salicylates are known to cause denaturation of hæmoglobin[2,3], but the action appears to be reversible and of a different nature from that just described. It is likely that a study of the reaction of salicylates and related compounds on viruses will throw some light on the structure of virus proteins.

RUPERT J. BEST.

Waite Research Institute,
University of Adelaide.
Feb. 17.

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[1] Best, Rupert J., NATURE, 139, 628 (1937).

[2] Anson, M. L., and Mirsky, A. E., *J. Gen. Physiol.*, 17, 399 (1933).

[3] Holden, H. F., *Austral. J. Exp. Biol.*, 14, 291 (1936).

Coprophagy in the Rabbit: Origin of 'Night' Fæces

IN a previous communication[1] it was mentioned that there were significant differences in ash content between the ordinary 'day' fæces of the rabbit and the softer 'night' type obtained when coprophagy was prevented by collaring. Further investigation has shown even more striking differences in respect of other constituents, notably in protein and fibre.

A rabbit was fed for a week on a diet consisting of equal proportions of bran and oats at the rate of 50 gm. per day and the ordinary fæces collected. It was then provided with a large wooden collar and 'day' and 'night' fæces collected separately. Analysis showed that the 'day' fæces were very similar to the ordinary fæces of the uncollared period but very different from the 'night' fæces. Data on the food and on the two types of fæces, all referred to a dry matter basis, are as follows:

	Food (per cent)	'Day' fæces (per cent)	'Night' fæces (per cent)
Crude Protein ..	14·7	9·2	28·5
Ether Extract ..	5·2	1·7	1·1
Crude Fibre ..	11·7	28·9	15·5
N-free Extractives	63·6	52·0	43·7
Total Ash ..	4·8	8·2	11·2
P_2O_5	2·1	2·9	5·0
Na_2O	—	0·15	0·3
K_2O	—	0·65	2·1

Of the 28·5 per cent so-called 'crude protein' (total N × 6·25), 25·8 per cent was insoluble after treatment with copper hydroxide, as in the method for determining 'true protein', and about half was readily soluble when incubated with pepsin-HCl at 37° C., and the suggestion is that it is largely bacterial debris. This rise in protein nitrogen, in conjunction with reduction in fibre content as compared with 'day' fæces, suggested cæcal origin of 'night' fæces and a further experiment was carried out to test this point.

A rabbit was collared and fed as before on a bran–oats mixture, 50 gm. being supplied at 9 a.m. each morning. Of this about two thirds was consumed by 5 p.m., the remaining third being cleaned up before the following morning. 'Night' fæces were collected for four days and the rabbit was killed at 9 a.m. on the fifth morning. Considerable food residues were found in the stomach, but very little in the intestines or rectum. The cæcum contained a little fluid material the dry matter of which corresponded to only 4 gm., compared with more than 15 gm. for an uncollared rabbit killed later in the day. Analyses of cæcal contents and of 'night' fæces collected prior to killing were as follows:

	Cæcal Contents (% dry matter)	'Night' fæces (% dry matter)
Crude Protein	39·9	30·0
Total Ash	11·2	11·1
P_2O_5	4·4	4·2
Na_2O	1·9	0·5
K_2O	1·2	1·7

The close similarity in composition of the 'night' fæces with residual cæcal contents strongly suggests a long sojourn of the former in the deeper regions of the cæcum and subjection of material from the small intestine to prolonged bacterial action, resulting in increased percentage of protein associated with concomitant reduction of fibre and other non-nitrogenous dry matter. The composition of the 'day' fæces, particularly their higher fibre content and correspondingly lower 'crude protein' (including any undigested nitrogenous debris), suggests more direct passage through the gut with limited sojourn at the sacculus end of the cæcum.

The broad statement by Madsen[2] and by Taylor[2] that the two types of fæces are due to variations in "intestinal rhythm" provides no explanation of the actual sequence of events. The sequence now suggested is a partial filling of the deeper regions of the cæcum as the food contents pass on from the small intestine, associated with a partial more direct passage of digested material into the colon during the day, followed by extensive emptying of the deeper regions of the cæcum at night. The more regular passage of 'day' material presumably gives time for greater inspissation and a drier residue, the wetter 'night' fæces being accounted for by more rapid discharge of the deeper cæcal contents.

According to this view, the 'day' fæces would represent less completely digested food debris and this might be expected to be the portion more readily re-eaten. Although some 'day' fæces are reconsumed, the striking feature is the total disappearance of the more fully digested 'night' fæces when the inhibiting collar is removed. The 'night' fæces, however, are rich in protein and presumably swarming with bacteria capable of attacking cellulose. Is this of any advantage to the rabbit ?

A. Eden.

Veterinary Laboratory,
New Haw,
Weybridge, Surrey.
March 26.

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[1] Nature, 145, 36 (1940).

[2] Nature, 143, 981–982 (1939).

Male Behaviour of the Female Starling (*Sturnus v. vulgaris*, L.) in Autumn

Witschi and Miller[1] have shown experimentally that the yellow bill colour of the starling in the breeding season is induced by male sex hormone. This yellow colour does not develop after the removal of the ovary or the testes, but in such castrated animals it may be induced in either sex by injections of androgenic substances. Œstrogenic substances have no effect on bill colour. It is concluded that the ovary produces male sex hormone, and that the most prominent secondary sexual character of the female starling is in fact a male character.

It has now been observed that the bills of adult British starlings of both sexes begin to turn yellow at the end of October, the time when the testes first show signs of activity. As the change in bill colour is a specific indication of the presence of androgenic substances, it is clear that in autumn both ovaries and testes are secreting male sex hormone. This has been found to have a marked effect on behaviour. At this time of year there is a burst of song which continues throughout November, and although in the breeding season the male alone sings, in autumn the habit is also developed by the female. This has been established partly by observation and partly by the examination of birds shot while singing. A similar effect has been produced experimentally by Leonard[2], who showed that the female canary, *Serinus c. canarius* (L.), when injected with male sex hormone, sings like the male. The song of the starling decreases in volume in December and January, particularly in severe weather, and when, in late February, it again increases it is produced by the male alone. At this time the ovary is growing and is probably secreting female sex hormone in such quantity that any effect on behaviour due to the presence of male sex hormone is obscured. The continued yellow coloration of the bill is proof, however, that male sex hormone is still being produced in the female bird.

The autumn change in bill colour, with its associated behaviour, occurs only in the British starling. The Continental birds present in the British Isles in autumn and winter retain the dark bill until January, and there is no autumn song by either sex. It has already been shown (Bullough and Carrick[3]; and unpublished) that the gonads of these immigrant starlings mature later in the season than those of the British birds.

The occurrence of male behaviour in autumn has been observed in the females of several other species of birds, and it is probable that these, like the female British starling, are under the influence of male sex hormone. In the robin, *Erithacus rubecula melophilus*, Hart., for example, Lack[4] has shown that in autumn individuals of each sex stake out territories and hold them with fighting and song. In this species, as in the starling, normal female behaviour reasserts itself early in the year when the female birds abandon their own territories and enter those of the males. This apparently widespread phenomenon of male behaviour on the part of female birds in autumn has proved difficult to explain in terms of ecological factors alone, and it is probable that other aspects of animal behaviour will be better understood when it becomes possible to correlate them with the condition of the endocrine balance.

University of Leeds.
March 9.

W. S. Bullough.
R. Carrick.

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[1] Witschi, E., and Miller, R. A., *J. Exp. Zool.*, **79**, 475 (1938).

[2] Leonard, S. L., *Proc. Soc. Exp. Biol. Med.*, **41**, 229 (1939).

[3] Bullough, W. S., and Carrick, R., Nature, **144**, 33 (1939).

[4] Lack, D., *Proc. Zool. Soc.*, A, **109**, 169 (1939).

Chalk Landscape

The communication of Lord Kennet of the Dene[1] reminds me of a note I wrote recently in an account of the ice storm of the end of January and of the thaw that occurred a week later. On the evening of February 3 rain began and by the morning of February 4 there was a strong thaw. But the ice below the snow and the frozen ground did not let the water soak away, with the result that there was much flooding. In the Cotswolds water poured over the frozen slopes, and at Bagendon the valley became a raging torrent four to five feet deep. Even here, 700 ft. above the sea, there was much flooding and for a time some roads were impassable. It has occurred to me more than once when watching the run off of water in a thaw after the ground has been frozen that such scenes must have occurred in the south of England on a much larger scale every spring during the Ice Age, and I have wondered whether this may not have contributed, or may not have been the chief cause, in the formation of the dry valleys of the chalk country.

C. J. P. Cave.

Stoner Hill,
Petersfield.
March 24.

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[1] Nature, 145, 466 (March 23, 1940).

Government Recruitment of Scientific Workers

The recent valuable leading articles to Nature have stressed the need for a scientific approach to many of our present national problems, Experienced men of science are necessary to ensure that scientific knowledge is properly applied and any developments which affect the recruitment of scientific workers should be critically considered.

It has come to the notice of the Association of Scientific Workers that certain Government departments have, since the beginning of the War, engaged scientific workers on a temporary basis at very low salaries. Both the temporary nature of the appointment and the low remuneration demand urgent attention. It is true that many civil service posts are now described as temporary appointments although they carry the same salary and pension rights as before the War; but the new feature of the appointments to which I refer is the absence of pension rights and the unreasonably low level of the salaries.

It appears that new low grades are being created without any reference to the scheme of the Carpenter Report, which formed the basis of the conditions of employment of men of science in Government departments, and which was accepted by the Department of Scientific and Industrial Research. In urging the necessity for an early revision of these temporary 'extraordinary' posts, I would recall the fact that after the War of 1914–18 certain men of science were kept in such temporary posts for periods up to ten years. The second aspect of the matter, namely, the poor remuneration, is perhaps even more important. In the cases referred to above the personnel was drawn from the Central Register, and possessed qualifications which would normally command a much higher salary than that offered. It appears that there may be two explanations of this state of affairs: either a number of highly qualified people have by mischance been appointed to junior posts, or else it may be a definite policy of the Treasury to recruit men of science to Government service at unusually low salaries. In either case, the matter should receive the attention of all professional scientific bodies.

Lastly, the difficulty of learning the conditions under which appointments are at present being made should be emphasized. The normal practice of advertising scientific posts has been largely replaced by direct approach through the Central Register. The greater facility with which suitable personnel can thus be found is an obvious advantage; but some means should be found whereby scientists in general can take cognizance of the new conditions of employment which are being imposed on them. Since so many of these new appointments are in Government service, it might suffice if there was a regular publication from time to time of the terms of employment. Such information should be pressed for by the Parliamentary and Science Committee.

W. A. Wooster.
(Hon. General Secretary.)

Association of Scientific Workers,
30 Bedford Row,
London, W.C.1.
April 5.

Points from Foregoing Letters

From spectrograms of twilight, taken in the zenith and horizontally, L. Vegard concludes that the yellow line of twilight comes from the lower part of the auroral region, and is due to extra-terrestrial sodium, possibly emitted by the sun.

J. Govaerts finds it possible to study the β-ray absorption of $^{32}_{15}$P through aluminium by means of a photographic method. The results are in good accord with those obtained by other methods.

The inductive effect of the substituted dipoles does not completely account for the dissociation constants of mono-, di-, and trichloroacetic acids. An explanation is put forward by H. O. Jenkins in terms of resonating structures involving C—Cl bonds of partial double-bond character. A linear relation exists between log n, where n is the number of possible valence bond structures, and log K, where K is the dissociation constant.

Lord Rayleigh writes to point out that the first vacuum vessels were made for Sir James Dewar by his assistant R. N. Lennox, and that they were only made later by C. E. Muller.

It has been asserted that the slowing up of a moving clock cannot be detected experimentally. F. C. Powell describes an experiment that appears to contradict this assertion. In his reply, H. Dingle says that such experiments are possible, but that they cannot confirm or deny the relativity requirement. He still maintains that his 'mass-clock' is a valid instrument.

Deoxycholic acid, one of the acids present in the bile of the higher vertebrates, including man, has been shown by J. W. Cook, E. L. Kennaway and N. M. Kennaway to produce spindle-celled tumours when injected *sub cutem* in sesame oil into mice. Deoxycholic acid has been shown previously to be convertible *in vitro* into the cancer-producing compound methylcholanthrene.

R. J. Best has found that neutral solutions of potassium salicylate inactivate the viruses of tobacco mosaic and of tomato spotted wilt. In the presence of potassium salicylate at suitable concentrations, solutions of tobacco mosaic virus deposit a solid, insoluble, denatured, inactive virus protein, the solution at the same time losing its anisotropy of flow. The rate of inactivation is logarithmic.

A. Eden reports that there are pronounced differences in chemical composition between the 'day' and 'night' fæces of the rabbit, chiefly in crude protein, fibre and mineral content. The close similarity in composition between the dry matter of the 'night' fæces and the cæcal contents suggests that the former are derived from material which has been subjected to prolonged bacterial action in the cæcum.

It has been observed by W. S. Bullough and R. Carrick that in autumn the bills of female British starlings start to turn yellow, a fact which indicates that the ovary is secreting male sex hormone. Under the influence of this hormone the female bird sings like the male.

RESEARCH ITEMS

Removal of Front Teeth in Man

THE non-curative removal of two or more of the front teeth in man is a practice which has an almost world-wide distribution in space, while in time it has been observed in skulls dating from so far back as palæolithic times, occurring at this period both in Palestine and in Africa. Dr. Aleš Hrdlička, in a study of the practice (*Smithsonian Inst. Miscell. Coll.*, 99, 3 ; 1940), points out that the teeth, usually the incisors, but sometimes the canines, were not removed on account of dental caries or other pathological condition. By Neolithic times the custom was widespread over Africa, Australia, continental Asia and Japan, and had reached some parts of Europe. It still survives in parts of Africa, Australia, possibly Mongolia, and parts of South America. In America the custom had not been observed among either Eskimo or Indians, as it had died out entirely, while in the skeletal evidence, which was scanty, the loss of teeth was likely to be overlooked. The first record of it comes from the material obtained by Dr. Hrdlička himself in the Aleutian Islands and Kodiak Island. He has now listed a large number of instances from American and Siberian collections, his conclusion being that "there is ample evidence that non-curative removal of some to all of the front teeth has been a widespread procedure since Neolithic times in northern Asia and since the oldest known times in America. . . . It shows features indicating strongly that it was essentially a ritual sacrificial observance".

Fossil Man of Monte Circeo, Italy

AN account of the palæolithic caves of Monte Circeo on the borders of the Pontine Marshes, Italy, and of the fossil remains of Neanderthal man discovered there by A. C. Blanc in February, 1939, is contributed by him to the *Revue Scientifique*, 78, 1 (1940) ; it contains further particulars of the remains and of the circumstances of the find. These caves, of which there is a large number, are situated in a calcareous limestone ridge at the edge of the plain. Some have been known as the source of a fossil fauna and worked flints for a considerable period ; but although visited in 1817, no systematic examination of them was made until 1883. Between 1936 and the discovery of Neanderthal man in the Guattari Cave in 1939, M. Blanc had investigated thirty-one caves, in twenty of which the removal of the contents by wave action and other agencies had left traces of the pleistocene filling, making it possible in many instances to reconstruct the stratification even before excavation began ; while in ten were the remains of a fossil fauna and flora as well as of palæolithic industries. Up to the time of the discovery investigation had revealed that a cold fauna associated with Aurignacian was superimposed upon a warm fauna (*R. Mercki* and *E. caballus*) and a Mousterian industry. The present find of a Neanderthal skull was made in the third of a series of three communicating chambers in the cave, in which the floor of the first was covered with a heterogeneous collection of bones of a fossil fauna. The skull lay on the surface, completely free and surrounded by a ring of stones disposed in an oval. Bones of Bovidæ and Cervidæ were scattered about the chamber. Deposits on the walls pointed to a prolonged period of inundation. Staining indicates that the skull itself had also been half-submerged at the same time. The disposition of the skull and the evidently intentional enlargement of the foramen, which has been completely destroyed, point to funerary and magical rites, possibly a ritual feast. This would account for the absence of skeletal bones. In date, Monte Circeo man stands later than the Sacchopastore skull ; and probably when rockfalls closed the cave to occupation Würm II had already begun.

Causation of Silicosis

ALL dusts produced in industrial processes in excessive amount are injurious to the air-passages and lungs, but certain mineral dusts are the most harmful. These are liable to cause the condition known as 'silicosis', in which fibrosis and other changes occur in the lungs, frequently terminating in secondary tuberculous infection. Industrial experience pointed to those dusts containing a large proportion of free silica, such as quartz and flint, as being the most dangerous, and the material must be in the form of fine particles less than 10 μ in size, but not ultra-microscopic. In a recent publication, F. W. Simson and A. S. Strachan have tested the silicosis-producing action of a number of mineral specimens (*Pub. South Afr. Inst. Med-Res.*, 9, 95–122 ; 1940). These included sillimanite, orthoclase, muscovite, rutile, quartz and several mine dusts, glass and a residue from human silicotic lung ; all were reduced to particles of an appropriate size distribution. Several doses of suspensions of these dusts were injected intravenously into rabbits. The animals mostly survived at least a year before examination, when the tissues chiefly affected were found to be those of the liver, spleen, lymph-nodes and bone-marrow. Cellular nodules were formed with giant cells, the process culminating in dense fibrosis. The lungs were unaffected, as dust particles introduced intravenously do not reach the alveoli. Only the quartz, the mine dusts and the lung residue were active in causing the lesions, the inactive dusts—sillimanite, orthoclase, rutile, muscovite and powdered glass—producing no inflammatory reaction and no fibrosis. The experiments seem to conform with the current belief that quartz, flint, and other forms of *free* silica are the noxious elements in active dusts. The paper is illustrated with a number of plates of photographs of the affected organs and photomicrographs of the lesions present.

Glycolysis in Embryos

BY thorough freezing and grinding of the tissue, Meyerhof and Perdigon (*C.R. Soc. Biol.*, 132, 186 ; 1939) have prepared extracts of rat and chick embryo which produce lactic acid from glucose. The glycolytic power of the extracts after addition of cozymase is of the same order as that of the original tissues. The extracts also produce phosphoglyceric acid and lactic acid from hexose diphosphoric acid and pyruvic acid. These experiments support the idea that the reactions of glycolysis in all tissues involve phosphorylation and that the intermediate stages are similar to the processes occurring in alcoholic fermentation which were first revealed by Harden and Young.

Mosquitoes and Filariasis

IN 1924 Yamada reported that the mosquito common in Shanghai, *Anopheles hyrcanus* var. *sinensis*, was capable of acting as an intermediate host of *Wuchereria bancrofti*, although certain Culicines were more important as carriers. A series of tests have been carried out by Stephen M. K. Hu to determine the susceptibility of the Anopheles mentioned to experimental infections with the parasite (*Peking Nat. Hist. Bull.*, 14, 83 ; 1939–40). Specimens of Anopheles to the number of 381 were fed on a heavily infected case of *Wuchereria bancrofti*. They were allowed to live sufficiently long to permit the filarial larvæ to complete their development to the infective stage, and when dissected 80, or 20·9 per cent, were found with infective larvæ, to the number of 3·6 on an average to each mosquito. When Anopheles along with *Culex pipiens* var. *pallens* and *Culex vagans* were allowed to feed on an infected case, subsequent examination showed that the latter species had a higher percentage of positive infection as well as a larger number of infective larvæ to each individual. Natural infection shows the same result. Of 87 Anopheles and 245 *Culex pipiens* var. *pallens* collected at the same time in a filarial house in Woosung, 4·6 per cent of the former and 17·2 per cent of the latter were found with filarial larvæ.

Young Caranx in the Western North Atlantic

J. T. NICHOLS (*Bull. Bingham Oceanograph. Coll.*, Peabody Museum of Natural History, Yale University, 7, Art. 2 ; 1939) gives a key to the young Caranx of the West Indian Region. The distribution of these young fishes is interesting, both *Caranx ruber* and *C. crysos* occurring in the Gulf Stream, *C. bartholomæi* inhabiting the drifting Sargassum weed, usually at or beyond the edge of the current and not actually in the Stream itself. The Gulf Stream appears to be the nursery ground for *C. ruber* and *C. crysos*, the latter occurring far to the north-east, and it is shown that the young are of such a small size that they must drift far to the east before reaching a stage in which they can swim independently of the current. These two species with their young most confined to the Stream, grow into the slenderest and swiftest of the Caranx in this region, and, presumably, they have the widest range. A good series of the young of *C. crysos*, less than 50 mm. in length, shows that the character of pigment spots, some of which are large and conspicuous, are useful in distinguishing this species from its relatives at so small a size.

Purification of Insect-transmitted Viruses

SPECIFIC nucleo-proteins have been isolated from plants infected with the more stable viruses, but those pathogens which are only transmitted biologically, by grafting or insects, have not been so purified. F. C. Bawden and N. W. Pirie show, however, that this is possible (*Brit. J. Exp. Path.*, 20, 322–329 ; 1939). They used potato virus '*Y*' and Hyoscyamus virus 3, and succeeded in obtaining yields of liquid crystalline nucleo-protein between 0·5 mgm. and 3 mgm. per litre of infective sap. Such preparations were infectious, but the methods used in purification seemed to lower the infectivity without destroying the serological activity. The physicochemical properties of the preparations closely resembled those of potato virus *X*.

Intranuclear Inclusions in Virus-infected Plants

INCLUSIONS which occur in the tissues of host plants infected with virus diseases have all been described as intracellular. Animal viruses, however, induce, in addition, intranuclear bodies in the cells of their hosts. Basilios Kassanis has now described (*Ann. Appl. Biol.*, 26, No. 4, 705–709 ; 1939) two kinds of body in the cells of solanaceous plants infected with severe etch virus. One type of inclusion occurs in the cytoplasm and is similar to the common X-bodies ; the other occurs only in the nuclei. This type appears to be crystalline in the form of thin rectangular plates, and to resemble the inclusions associated with the polyhedral disease of silkworms.

Rooting of the Olive Tree

J. VIEIRA NATIVIDADE has published (*Agronomia Lusitana*, 2, 25–73 ; 1940) a very interesting note upon a method of root production in the olive which seems so far to have escaped attention. Excrescences on the base of the trunk have been known for centuries and used for purposes of propagation ; they contain much parenchyma with stored food reserves and possess dormant buds. Natividade's anatomical study now shows these excrescences also contain a number of root initials ; these arise near the vascular cambium and, as they enlarge, the root cap may often be cut off by the phellogen and buried in the cork. These excrescences may be formed at various levels in the trunk but are invariably linked with the ground by a cord-like strand on the trunk surface. These cords seem to represent aerial roots fused with the trunk and when they reach the ground they give rise to a root system. The accumulation of these excrescences and their linked basipetal cords form the typical fluted bole of the olive, and the whole original root system of the tree is replaced by the later root system developed from these superficial cords. This is true whether the original root system was that of a seedling, a cutting or a root stock. Thus the textbook instruction to propagate the olive by grafting in order to obtain a deep root system rests on a fallacious argument.

Carbohydrate Manuring

INDIAN soils normally contain much less nitrogen and organic matter than those of more temperate regions, and the use of molasses as a fertilizer has received considerable attention and met with some success. Recently, N. R. Dhar of Allahabad has claimed remarkable increases in nitrogen fixation by the use of molasses and other energy-rich materials, including fats. An account of this work was presented at the First International Fertilizer Congress in Rome in 1938 and is summarized by H. E. Z. Raczkowski in *Hadar* (Nov. 1938), the Palestine citrus journal. According to Prof. Dhar, carbohydrates, glycerol, paper, straw, sawdust, etc., increased nitrogen fixation. Light is said to be utilized as in photosynthesis. In field trials, 3 tons of molasses added 112 lb. of nitrogen per acre, and 10 tons fixed 270 lb. of nitrogen. The nitrogen thus fixed was retained in the soil much longer than when ammonium sulphate was added. In sterilized soil nitrogen fixation occurred in the complete absence of micro-organisms, provided light was available. It is thus claimed to be a photo-chemical process. Contrary to the general belief, Prof. Dhar says that fats are readily oxidized in tropical soils and provide considerable energy for nitrogen fixation.

Zea-Euchlæna Hybrids

D. S. LANGHAM (*Genetics*, 25, 82–108 ; 1940) shows that three out of the five characteristic differences between maize and teosinte are inherited as unifactorial characters. These are weak response : strong response to length of day, paired female spikelets : single spikelet and many ranked : single-ranked ear. The dominant character is given first in each case. The results support the theory that maize arose from teosinte by a few large-scale mutations and disagree with the view that maize and teosinte differ in thousands of genes.

Recent Trends in Earthquake Insurance

A. C. CHICK considered this subject in a paper presented to the annual meeting of the Eastern Section of the Seismological Society of America on June 9, 1939 (*Earthquake Notes*, 11, No. 3 ; Jan. 1940). Attention was directed to the strong motion seismograph developed by the Coast and Geodetic Survey, and the model experiments of Prof. Ruge to determine earthquake effects on structural designs. In particular, the volume of earthquake insurance became greater in the United States after the Long Beach earthquake, but decreased after the emotional effects of the earthquake had worn off. Soon after the Santa Barbara earthquake in 1925, the premium on earthquake insurance in California amounted to approximately three million dollars, but by 1928 this had dropped to approximately two million dollars, and by 1932 it had further fallen to three-quarters of a million dollars. In June 1939 the total premium on earthquake insurance written in the United States, as reported to insurance commissioners, amounted to about one million dollars. The large earthquakes in various parts of the world have had little influence on this, but quite a little activity in the United States was stimulated by the New England hurricane of September 1938. Chick concluded that the rates for earthquake insurance were still high compared with fire insurance rates, but that this must necessarily be so as long as the requests for this type of coverage came chiefly from those areas which were recognized as being seismically active.

Atomic Weight of Holmium

THE investigation of holmium with the mass-spectrograph has shown that the element is composed of one type of atom only, with a mass of 165. It is difficult to determine the chemical atomic weight with accuracy from this figure, as the packing fractions of the rare earth elements have not been directly determined, but can only be estimated from Dempster's packing fraction curve. If, however, the value $-0{\cdot}8$ is taken for this, and Smythe's correction factor (0·999725) is used, the value obtained for the chemical atomic weight is 164·94. O. Hönigschmid (*Naturwiss.*, 27, 855 ; 1939) points out that this is considerably higher than the international value of 163·5 at present accepted, the latter being probably too low in consequence of the presence of impurities, chiefly yttrium, in the holmium preparations used for analysis. A holmium preparation of a high degree of purity has now been obtained. X-ray methods show that it contained only $0{\cdot}013 \pm 0{\cdot}004$ at. per cent of yttrium, about 0·04 at. per cent of erbium, and 0·03 at. per cent of dysprosium, and less than 0·02 at. per cent of other elements. Analysis of the holmium trichloride obtained from this preparation gave as a mean the value 164·935 for the atomic weight. When corrected for the amount of yttrium present, the value becomes 164·944, which is almost identical with the value calculated from mass-spectrograph data.

Proton-attracting Properties of Liquids

RECENTLY many investigations in infra-red spectroscopy have been concerned with the properties arising from the formation of 'hydrogen bonds'. If a common solute, which can act as a proton donor, is dissolved in various proton-acceptor solvents (bases), the tendency to form hydrogen bonds should be governed by the strength of the base. To test this, Gordy and Stanford (*J. Chem. Phys.*, 7, 93 ; 1939 and 8, 170 ; 1940) have examined the OD band of CH_3OD in some fifty solvents. In benzene CH_3OD is monomeric and the OD band is at 2681 $cm.^{-1}$. The extent to which this band is shifted to longer wave-lengths on solution is taken as a measure of the strength of the 'hydrogen bond', and hence the stronger the bond the more basic the solvent. The power of solvents to form hydrogen bonds is in the order : esters $<$ aldehydes and ketones $<$ ethers $<$ amines. The effects of substitution and unsaturation on the proton-attracting power of the oxygen or nitrogen atom with which the OD forms a bond are discussed. Comparison of the observed shifts in location of OD bands with the dipole moments of the solvents shows no correlation between the magnitude of the moment and the extent of the shift. Thus the complexes are not formed entirely as a result of dipolar attraction. When the basicity constants are plotted against the wave-length shift a linear relationship is established from which, by extrapolation, the basicity constants of several solvents have been evaluated. A linear relationship exists also between the OD wave-length shift and the rate of semi-carbazone formation of some aldehydes and ketones. There is, too, close concordance between the shift and the solubility of monofluorodichloromethane (a proton donor) in various solvents.

Nuclear Reactions with Bismuth

THE Cambridge cyclotron has been used by D. G. Hurst, R. Latham and W. B. Lewis (*Proc. Roy. Soc.*, A, 174, 126) to investigate the reactions of bismuth bombarded with deuterons. The reaction $^{209}Bi(d, p)^{210}RaE$ was previously known from the work of Livingood, and the production of polonium by the reaction $^{207}Bi(d, n)^{210}RaF$ was found for the first time. The RaE decays to polonium with a half period about 5 days, so that the measurement of the polonium activity over a period of days provides a method for investigating the relative probability of the two nuclear reactions. A stack of aluminium foils thinly coated with bismuth was bombarded with deuterons, and the processes thus investigated for a range of deuteron energies. It is to be expected that the (d, n) reaction will occur if the deuteron enters the nucleus, while the $(d ; p)$ reaction is due to the Oppenheimer-Phillips process, in which the deuteron splits up on the surface of the nucleus and the neutron alone enters the latter. This view is, on the whole, borne out by the results of the measurements. The $(d ; p)$ reaction is apparently more probable than the other for all the energies studied, that is, up to 8 m.e.v.

DISTRIBUTION OF BRITAIN'S INDUSTRIAL POPULATION*

ALTHOUGH the Royal Commission on the Distribution of the Industrial Population, under the chairmanship of Sir Montague Barlow, completed its report in August 1938, the report was not signed and printed, owing to the international situation, until December 1939. The appointment of the Commission arose out of recommendations in a report of the Commissioner for the Special Areas, afterwards debated in the House of Commons, and its terms of reference covered the causes of the present distribution of the industrial population and the probable direction of any change in that distribution in the future; the social, economic or strategical disadvantages of concentration; and the remedial measures, if any, to be taken in the national interest. The minutes of evidence taken before the Commission have already been published independently, but the report includes among the appendixes a memorandum on the location of industry by Prof. J. H. Jones, analysing factors in location as well as post-War trends; some notes on garden cities, satellite towns and trading estates; and a memorandum on planning in some other countries by Mr. G. L. Pepler.

Consideration of the causes of the present distribution leads the Commission to conclude that in the absence of decisive natural factors such as the existence of coal or of an adequate supply of suitable water, industries tend to be located within easy reach of the market. The industries that have shown a relative expansion since 1918 are either local industries or industries in the location of which natural factors have not been decisive. The cost of power and transport is relatively low; in the past, such industries tended to settle in places like London and Birmingham, which were not suitable for the development of those 'basic' industries that are now declining; such places, therefore, became the legatees of the remainder of the industrial estate, particularly as they constituted or were near large markets. Moreover, the existence of cognate industries or common subsidiary industries, of industrial atmosphere and of a large and growing market, have accelerated a growth that was already taking place long before 1914.

In present conditions, it is difficult to predict the probable future course of trade or industry in Great Britain or elsewhere. Once normal and reasonable stable international conditions are established, however, it may be expected that the importance of the old 'basic' industries in the national economy may decline and that of other industries increase. Industrial areas containing the former will only be able to keep up with the national rate of general industrial progress if they stimulate within themselves a growth of the miscellaneous light industries in excess of the rate of growth of such industries in the country as a whole. While the attraction of London and the Home Counties may lose some of its force owing to the greater vulnerability of the area to attack from the air, the Commission sees no reason to suppose that, apart from this factor, and in the absence of some restrictive regulation by the Government, the trend to the south-east of England will be permanently checked when the rearmament policy has accomplished its purpose.

The Commission considers that the concentration of industry or of the industrial population in a large town or particular area should not, of itself, give rise to higher mortality rates than elsewhere or to other social disadvantages, provided that the town or area is well planned. The bad planning of the existing large towns and areas of industrial concentration in Great Britain, however, inflicts certain disadvantages on their inhabitants through bad housing, lack of space for recreation, difficulties of transport, congestion, smoke and noise, which are often accentuated by unsatisfactory economic conditions. These disadvantages are the result of the haphazard manner in which urban development has proceeded in the past, and could be remedied or greatly reduced by good planning. Accordingly, policy should be directed to the continued and further redevelopment of congested urban areas, where necessary, having due regard to the retention of the advantages of a well-planned town and the addition, so far as possible, of the cultural and physical aspects of the country; decentralization and dispersal of both industries and industrial population from such areas, and provision of checks to the further growth of London.

The economic advantages of concentration of industry in proximity to market, reduction of transport costs and availability of a supply of suitable labour are accompanied by disadvantages such as heavy charges on account of high site values, loss of time through street traffic congestion in the very large towns and the adverse effects on efficiency and output of the fatigue incurred by workpeople through long daily journeys between home and workplace, often under considerable discomfort. Strategical considerations further support a policy of decentralization or dispersal of industry from overcrowded areas, which is already desirable to counteract the social and economic disadvantages of concentration.

The report then reviews in turn related questions of town planning, garden cities, satellite towns and trading estates. The well-considered development of garden cities, satellite towns and trading estates should offer a useful contribution to the relief of overcrowded and congested urban areas, but such development is unlikely to be successful if left entirely to private enterprise on account of the magnitude of the financial commitments involved. Accordingly, the Commission recommends that the proposed National Industrial Board should examine and formulate the policy to be adopted in relation to the development or encouragement of such methods where decentralization or dispersal is desirable, including adequate provision for the requirements of industry, social and amenity requirements, avoidance of unnecessary competition, and due regard to strategical considerations.

Further chapters deal with population trends, the problem of the special and depressed areas in relation to the balance of industry throughout the country, different types of cities and the problem of congestion and some aspects of the problem of London. In regard to the special areas, the Commission recommends that the National Industrial Board should, in the light of the experience of the Special Areas legislation, study the location of industry throughout Great Britain with the dual object of anticipating cases where depression may occur in the future and encouraging before a depression crisis arises the development of other industries or public undertakings, and of encouraging a reasonable balance of industrial development throughout the various divisions or regions of Great Britain. Adoption of a regional system, it is considered, would materially facilitate several of the problems before the Commission.

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* Royal Commission on the Distribution of the Industrial Population. Report. (Cmd. 6153.) Pp. x+320. (London: H.M. Stationery Office, 1940.) 5s. net.

From the evidence submitted, the Commission has reached the unanimous conclusion that the disadvantages in many, if not in most, of the great industrial concentrations constitute serious handicaps and in some respects dangers to the nation's life and development, and that definite action should be taken by the Government towards remedying them. The problems of the location of industry are national in character, touching on and overlapping those of agriculture, land, water, transport, roads, amenities, etc., and the solution must be sought along the lines of national inquiry and guidance. For the national action necessary in view of the nature and urgency of the problems, the Commission is of the unanimous opinion that a central national authority is required, the activities of which should be distinct from and extend beyond those within the powers of any existing Government department. The objectives of national action should be : continued and further development of congested urban areas where necessary ; decentralization or dispersal both of industries and population from such areas ; and encouragement of a reasonable balance of industrial development with appropriate diversification of industry throughout the country. The Commission is also agreed that the continued drift of the industrial population to London and the Home Counties constitutes a social, economic and strategical problem demanding immediate attention, and that the central authority, whether advisory or executive, should examine forthwith and formulate the policy or plan to be adopted in furtherance of the objectives indicated. The central authority should have the right to inspect all existing and future planning schemes and to consider the modification or correlation of such plans, where necessary, in the national interest. Appointment of a body of experts to examine the questions of compensation, betterment and development is also recommended, and the powers of the authority should include the collection and co-ordination of information relating to location of industry ; research ; collection of information as to the various natural resources which may be affected by industrial location ; advisory functions on problems of location ; and publicity and annual reports.

Differences of opinion are revealed in regard to the machinery of Government action. The majority report recommends that a National Industrial Board should be appointed by the President of the Board of Trade after consultation with the Ministers of Health, Labour and Transport and the Secretary of State for Scotland, for making research into, advising upon and regulating the location of industry. In addition to the functions already outlined, the Board should have power to establish regional bodies to study problems of industrial location, and it should be required to report what executive powers it requires generally for giving effect to the agreed objectives of national action. The Board should also from the outset be invested with power to regulate the establishment of additional industrial undertakings in London and the Home Counties, including power to refuse consent to the establishment of a new industrial undertaking unless it is established to the Board's satisfaction that the undertaking cannot be conducted on an economic basis elsewhere. Provision should be made, moreover, for the application by Order in Council of similar regulation to other specified areas.

These recommendations are signed with reservations by three signatories, Prof. J. H. Jones, Mr. G. W. Thomson and Sir William E. Whyte, who consider it should be the duty of the proposed new Board to give continuous study to the problem of achieving a well-balanced industrial society, and that the problem of location cannot be separated from the national problem of persistent unemployment. Accordingly, they recommend that the establishment of divisional or regional bodies should not be optional but a definite requirement of the scheme of regulation or control. They also insist that the Board should be required to report on the further powers required at the earliest possible moment ; that the powers of negative control apply equally to the whole country ; that the powers of the Commissioners for the Special Areas, so far as they bear upon the work and functions of the Board, should be transferred to the latter ; and that the Board should be in a position to offer the inducements they consider necessary to secure a better balance and greater diversification of industry throughout the country.

The minority report, which is signed by Prof. Patrick Abercrombie, Mr. M. H. Elvin and Mrs. Hichens, differs from the majority report in the stress it lays on the urgency of the problem and upon the necessity for granting far-reaching executive powers to a new Government department or one evolved from an existing department. The signatories consider that the unprecedented amount of new factory location taking place and the altered character of war risks with re-location involved make the problem an immediate one. The new ministry should take over some of the planning functions of the Ministry of Transport and possibly of the housing functions of the Ministry of Health, and the powers and functions of the Commissioners for the Special Areas should be transferred to it, with general application. Its functions would be inquiry and research to lead up to a systematized plan for distribution of industry on a national scale, with a better balance in the distribution of population, and, pending the evolution of such a national plan, control of changes in the present distribution of industry. The ministry would be assisted by a strong central advisory commission as well as by regional boards. The minister would be empowered to exercise negative control over the establishment and location of new industrial undertakings or extensions of existing ones, and to schedule areas in which development would be permitted or prohibited. He would be empowered to impose the requirements of the general development plan, prepared by the commission of research, upon regional and local planning schemes, as well as to authorize financial assistance to encourage desirable industrial location and proper planning, including the assistance of projects of national importance such as national parks. A dissentient memorandum in criticism of present planning powers and practice is contributed by Prof. Abercrombie.

PHYLOGENY AND TAXONOMY

A JOINT meeting of the Linnean Society and the Association for the Study of Systematics in relation to General Biology was held in the rooms of the Linnean Society on April 11, at which a discussion took place on phylogeny and taxonomy.

Mr. J. S. L. Gilmour, opening the discussion, distinguished between 'general' classifications, based on a maximum correlation of attributes, and 'special' classifications, based on selected attributes. Taxonomy has a clear aim of its own, apart from phylogeny, namely, the construction of a 'general' classification of living things for the purpose of conveniently summarizing empirically discovered correlations and of making predictions based on them.

The concept or 'relationship' was defined in terms of genealogical lineages and was regarded as only one of the factors making up phylogeny or the "history of the origin and development of groups". Relationship, thus defined, cannot be regarded as the *basis* of taxonomy, but rather as the *explanation* of the possibility of making a 'general' classification of living things with a high degree of correlation. A lineage classification, based on relationship, is really a special classification made for the purpose of correlating relationship with other attributes. The view that taxonomy is necessarily phylogenetic is an error due to a misunderstanding of the nature and aim of a 'general' classification.

Dr. O. W. Richards pointed out that, if evolution is a fact, a phylogenetic classification must exist. In addition, however, a classification can be made in which a large number and varied assortment of characters are correlated. Is such a classification the same as a phylogenetic one ? Pre-Darwinian and present-day taxonomic methods are, broadly speaking, very similar, but nevertheless evolutionary theory has had a profound effect on post-Darwinian taxonomy in two main ways : (1) series of groups showing progressive change are held to have some relation to evolutionary change, and this affects the taxonomic treatment of the groups ; (2) our general knowledge of the cause of evolution enables us to orientate such series. Whether these changes have always brought our classifications nearer the true phylogenetic one is often difficult to decide and must await crucial palæontological evidence. In the long run, a classification approximating as nearly as possible to phylogeny will prove practically the most successful.

Dr. T. A. Sprague agreed with Mr. Gilmour that a natural classification in biology is based on degrees of resemblance and difference, but not necessarily on maximum agreement in total characters. He pointed out that, apart from the difficulty of deciding what are unit characters, general plan of structure far outweighs details, and that greater weight should be assigned to non-adaptive than to adaptive characters. The natural classification in botany has been developed synthetically by a process of trial and error, and the characters eventually employed in the resulting groups have been observed, not arbitrarily selected. The fact that so many groups of the Angiospermæ, large and small, originally based only on external morphology, have been confirmed by independent consideration of their anatomical, cytological and biochemical characters, suggests that a high proportion of the recognized groups, from species to families inclusive, is monophyletic. In the absence of relevant fossil evidence, however, the general inter-relationships of the orders cannot be determined. Most phylogenetic trees of the Angiospermæ are based on hypothetical evolutionary floral progressions, and are essentially morphogenetic diagrams, representing postulated stages in general floral evolution. Agreement in general plan and non-adaptive characters between particular orders makes phylogenetic relationship between them seem highly probable, but the greater part of such phylogenetic trees seems to be purely speculative.

Dr. E. I. White stated that, primarily, taxonomy and the study of phylogeny are distinct and not necessarily interrelated. The former deals with the arrangement of organisms into groups determined by the number and nature of common characters, which might be arbitrary, while the latter is concerned only with the ancestry of organisms, that is, their true relationships, determined by the appraisement of characters common to the several organisms the selection of which cannot be arbitrary. Were all facts known, a phylogenetic tree and a sound taxonomic arrangement would coincide, but this postulates evidence in both space and time. It is the work of palæontologists to provide such evidence, and to them a taxonomic arrangement without a phylogenetic basis is only a temporary expedient due to lack of evidence.

Dr. Hamshaw Thomas, in a written communication, puts forward the view that, if phylogeny is to be built on a firm foundation, we must replace the present deductive methods by inductive reasoning based on the statistical investigation of empirically discovered correlations. We are at the parting of the ways ; the rejection of the classical concepts of floral morphology has reduced current phylogeny to a mass of ruins, and a century may elapse before it can be rebuilt. Meanwhile, supposed phyletic series based on typological morphology have no place in taxonomy, which should follow the principles of a natural classification laid down by Lindley more than a hundred years ago. If eventually such a classification suggests a course of evolution agreeing with that discovered by phylogenetic studies, so much the better, but at present taxonomy and phylogeny should develop independently.

Space will allow of no more than a few brief abstracts from the remarks made by speakers in the somewhat lively discussion that followed the reading of the main papers. Dr. Julian Huxley pointed out that there are two main trends of thought : that accepting phylogenetic facts or inferences as the basis of taxonomy, and that contending that classification should be based on correlation of characters with the possibility of explaining the results of such classification phylogenetically. He did not think the two points of view are irreconcilable. Dr. W. B. Turrill considered that much so-called phylogeny is, for the Angiosperms, pseudo-phylogeny. He particularly emphasized the danger of including phylogenetic facts or assumptions, however concealed, in a classification if that classification is later to be used as furnishing proof for a given phylogenetic scheme. Sir William Wright Smith was convinced that it is impossible to establish a phylogenetic system for plants that can be more than highly speculative, in the absence of relevant fossil evidence.

Dr. R. Melville stated that the papers and discussion showed the need for a thorough revision of the logical basis of both taxonomy and phylogeny. Mr. B. L. Burtt said that Dr. Sprague claimed no more than that taxonomic groups are monophyletic, members of a logically 'natural' group being of common origin. A phylogenetic classification does not seem possible in the absence of fossil evidence. Dr. J. Burtt Davy said that in teaching taxonomy a phylogenetic basis is a great help. Mr. M. J. D. White said that it is evident that very different points of view are held by those who work with different groups of organisms. He believed that cyto-genetics will have much to contribute to the subject in the future. The president (Dr. J. Ramsbottom) said, in closing the discussion, that in the fungi the fossil evidence is quite unreliable and that the so-called phylogenetic trees from time to time published for this group are based on such superficial evidence as to be sheer nonsense.

RELATIONSHIPS OF THE FUCALES

AS recently as 1937 Kylin expressed the view that the Fucales occupy an isolated position and have not been derived from the Phæosporeæ. Dr. M. Delf has reviewed the basis for this conception in the light of recent work on the higher Ectocarpales (*New Phyt.*, 38 ; 1939) and shows that Kylin's view cannot be too easily accepted.

The apical growth, which has been regarded as a difficulty in relating the Fucales to the Ectocarpales, has been shown by Nienburg to be preceded in the sporeling by an apical tuft of hairs, and the apical cell is derived from the basal cell of the intercalary growing zone of one of these. A rather similar development of conceptacles and cryptostomata in Fucales from growth originating from the base of a hair has some resemblance with the slightly sunken tufts of hairs of Colpomenia, Leathesia, etc.

The problem of the differences in ciliation of motile cells, the longer cilium, anterior in Fucus, usually posterior in Ectocarpales, seems a point of doubtful value and apparently liable to greater variation than was formerly realized.

Dr. Delf points out that the structure of the Fucus thallus could be derived from such a type as Eudesme, as described by Parke. She suggests that in place of the alternation of generations shown by the higher Ectocarpales, the Fucales have developed a perennial macrosporophyte and, possibly associated with adaptation to the intertidal zone, the gametophyte has suffered extreme reduction. It is of interest in this connexion that the Fucales of warmer waters remain submerged, and in Cystoseira and Sargassum, etc., the contents of the oogonium may be extruded in the 8-nucleate condition, which is in effect equivalent to a small haploid gametophyte, and from this the single oosphere is derived by degeneration of the remaining nuclei.

SEVENTY YEARS AGO

NATURE, vol. 1, April 21, 1870

Experimental Research and Unemployment

AN essay by George Gore, F.R.S., entitled "On Original Experimental Research in Relation to Employment for Workmen", shows that the struggle for recognition of the significance of scientific discovery for social progress had already begun.

"The variety and extent of the employments which have resulted from scientific research are so great that they ramify in some form or other through nearly all our manufacturing, artistic, and commercial occupations, our social relations, and our everyday life. . . . In many instances the application of original experimental science in new inventions had superseded, and in a limited sense diminished, manual labour, but it has in such cases either substituted more intellectual occupation for it, or has opened up new sources of employment to a far greater extent by increasing trade and manufacture. . . .

"The extension of physical and chemical knowledge by means of experiments and observations is *national* work : it benefits the nation, but does not pay the investigator. . . . Has it been wise in our Governments thus to overlook a great source of the nation's wealth, to disregard a most important means of national economy, to neglect the great fountain-head of industry ?"

Channel Railways

THE third of the series of articles on direct communication with France across the English Channel appears. It is devoted to discussion of "submerged roadways" or "tubes" of iron or concrete constructed on the sea bed.

Among the designs considered is that due to the late Mr. Chalmers, who proposed to have a gigantic tower or ventilator in mid-Channel, to which would be attached 400 ft. lengths of wrought-iron tube floated into position and drawn down by chains to the sea bottom.

Another scheme, considered in more detail, is that of Messrs. Bateman and Révy, who propose to lay a cast-iron tube on the sea bottom, starting from one shore and building it up inside a horizontal bell or chamber which is being constantly pushed forward. The tube would consist of cast-iron plates 4 in. thick lined with brick in cement, and carried on screw piles ; its inside diameter when completed would be 13 ft. The propulsive power for trains in such a tube would be pneumatic ; that is, the trains would be propelled by air forced into the tunnel by powerful pumps of large capacity in the form of gasometers.

ACCORDING to the *Photographic News*, the oft-reiterated statement that the eye of a dead animal has impressed upon it an image of the last object seen in life has been the subject of serious investigation in Germany. Americans have gone so far as to state that the eye of a murdered man had been found in which a portrait of the murderer was distinctly traceable. In the investigation in question the eyes of thirty different animals, all of which had been killed with a view to subsequent examination, were carefully inspected, but in no case was there any evidence discovered to warrant the statement referred to.

FORTHCOMING EVENTS

Saturday, April 20

Association of Scientific Workers (at the Guild of Undergraduates Union, Birmingham), at 3 p.m.—Conference of Industrial Scientists. (Speakers: J. S. Hunter: "Salaries, Cost-of-Living Adjustments, Overtime"; Dr. C. J. Milner: "Holidays and the Five-day Week"; J. Skeel: "The Problems of Assistants, (*a*) General and Economic Problems"; A. G. Ward: "The Problems of Assistants, (*b*) Problems of Technical Education": Dr. R. E. Priestley: "Science as a Reserved Occupation".

Tuesday, April 23

Institution of Electrical Engineers (Wireless Section), at 6 p.m.—Discussion on "War-Time Standardisation" (to be opened by P. R. Coursey).

Thursday, April 25

Institution of Electrical Engineers, at 6 p.m.—Dr. C. G. Darwin, F.R.S.: "Thermodynamics and the Coldest Temperatures" (Thirty-first Kelvin Lecture).

Friday, April 26

Royal Institution, at 9 p.m.—Dr. E. C. Bullard: "The Geophysical Study of Submarine Geology".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Borough Electrical Engineer and General Manager—The Town Clerk, Guildhall, Oswestry (April 26).

Principal of the Burnley Municipal College—The Director of Education, Education Offices, Burnley (April 26).

Lecturer in the Department of Pure and Applied Science—The Registrar, Loughborough College, Loughborough (April 27).

Assistant Livestock Expert for Animal Husbandry work in Bengal—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 9/2F) (April 27).

Male Teacher of English for British Institute, Genoa—The British Council, 3 Hanover Street, W.1 (quoting 'Italy') (April 27).

University Graduate as Teacher of English for British-Peruvian Cultural Association, Lima, Peru—The British Council, 3 Hanover Street, W.1 (quoting 'Lima') (April 30).

Temporary Adviser (male or female) in Horticulture—The Agricultural Organizer, Berkeley House, Berkeley Street, Gloucester (April 30).

Principal of the Ceylon University College—The Director of Recruitment (Colonial Service), Colonial Office, 29 Queen Anne's Gate, S.W.1 (April 30).

Assistant Lecturer in Geography—The Registrar, University, Manchester 13 (May 1).

Headmaster of Alleyn's School—The Clerk to the Governors, Dulwich College, S.E.21 (May 3).

Lecturer in Sinhalese—The Secretary, School of Oriental and African Studies (University of London), at Christ's College, Cambridge (July 1).

Assistant Engineer for the Public Works Department of the Government of Nyasaland—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9202).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Sheffield City Libraries. Research Bulletin No. 3: A Select Bibliography on the Production of Steel Sheets and Strip. Part 1: Ingot—Slab—Sheet. Pp. ii+11. (Sheffield: Central Library.) Free. [14

Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 7: A Method of Doubling the Yield per Unit Area of Lettuce Plants grown in Nutrient Solution. By R. J. Hayes. Pp. 83–90. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [14

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 21: Stabilised Diazo Complexes with Piperazine and other Bases. By P. J. Drumm, W. F. O'Connor and J. Reilly. Pp. 223–228. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [14

South-West Essex Technical College and School of Art. Annual Report, Session 1938–9. Pp. 36. (Walthamstow, London: South-West Essex Technical College and School of Art.) [14

Other Countries

Report of the Institute of Scientific Research, Manchoukuo. Vol. 3, Appendix 1: Lineamenta Florae Manshuricae, or an Enumeration of all the Indigenous Vascular Plants hitherto known from Manchurian Empire, together with their Synonymy, Distribution and Utility. By Dr. Masao Kitagawa. Pp. vi+488+12 plates. (Hsinking: Institute of Scientific Research.) [273

Canada: Department of Mines and Resources, Mines and Geology Branch: Geological Survey. Paper 39-1: Preliminary Report—Beaulieu River Area, Northwest Territories. By J. F. Henderson. Pp. ii+16+1 map. 10 cents. Paper 39-3: Preliminary Report—Mackay Lake Area, Saskatchewan. By M. L. Keith. Pp. ii+8+1 map. 10 cents. Paper 39-5: Preliminary Report—Snake River Area, Northwest Territories. By C. S. Lord. Pp. ii+18+1 map. 10 cents. Paper 39-6: Preliminary Maps—Quyta Lake and Parts of Fishing Lake and Prosperous Lake Areas, Northwest Territories. By A. W. Jolliffe. 3 maps. 10 cents. Paper 39-7: Preliminary Map—Cléricy Map-area, Abitibi and Témiscamingue Counties, Quebec. By W. C. Gussow, J. W. Ambrose and H. C. Gunning. 1 map. 10 cents. Paper 39-8: Preliminary Report—Reindeer Lake and Spalding Lake Map-areas, Saskatchewan. By L. J. Weeks. Pp. ii+4+2 maps. 10 cents. Paper 39-9: Preliminary Map—Waconichi Map-area, Abitibi and Mistassini Territories, Quebec. By G. Shaw. 1 map. 10 cents. Paper 39-10: Preliminary Map—Nelson Area, East Half, British Columbia. By H. M. A. Rice. 1 map. 10 cents. Paper 39-12: Preliminary Map—La Pause Area, Abitibi and Témiscamingue Counties, Quebec. By J. W. Ambrose and H. C. Gunning. 1 map. 10 cents. (Ottawa: King's Printer.) [273

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 192: The Different Factors affecting the Temperature of a Heap of Grain in the Open. By Rizk Attia. Pp. ii+50+43 plates. (Cairo: Government Press.) P.T. 10. [273

Annales scientifiques de l'Université de Jassy. Première section (Mathématiques, Physique, Chimie), Tome 26, Année 1940. Fasc. 1. Pp. iii+334. (Jassy: Université de Jassy.) 400 lei. [273

Field Museum of Natural History. Botanical Series, Vol. 22, No. 1: Studies of American Plants, 9. By Paul C. Standley. (Publication 463.) Pp. 62. 50 cents. Zoological Series, Vol. 24, No. 11: A Tentative Classification of the Palearctic Unionids. By Fritz Haas. Pp. 115–142. 20 cents. (Chicago: Field Museum of Natural History.) [273

Reports of the Japan Institute for Science of Labour, Inc. No. 44: How far Sensory Function Participates in Operations. By Kihati Huzimoto and Yosio Oeno. Pp. ii+24. (Tokyo: Japan Institute for Science of Labour, Inc.) 50 sen. [273

University of California Publications in American Archaeology and Ethnology. Vol. 38: Cultural and Natural Areas of Native North America. By A. L. Kroeber. Pp. xi+242. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 3 dollars. [283

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 26, No. 5 (Mathematics No. 42): Beiträge zur Geometrie der Kreise und Kugeln (34). Von Sôzi Matumura. Pp. 179–232. Vol. 26, No. 6 (Mathematics No. 43): Beiträge zur Geometrie der Kreise und Kugeln (35). Von Sôzi Matumura. Pp. 233–288. Vol. 26, No. 7 (Mathematics No. 44): Beiträge zur Geometrie der Kreise und Kugeln (36). Von Sôzi Matumura. Pp. 289–342. (Taihoku: Taihoku Imperial University.) [283

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 18, No. 5: On Walkomia n.gen., a Genus of Upper Palaeozoic Conifers from Gondwanaland. By Rudolf Florin. Pp. 24+4 plates. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [283

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 16: A Review of Educational Legislation, 1937 and 1938. By Ward W. Keesecker. Pp. v+54. (Washington, D.C.: Government Printing Office.) 10 cents. [293

National Research Council of Japan. Report, Vol. 2, No. 8, April 1938—March 1939. Pp. iii+609–728. (Tokyo: National Research Council of Japan.) [293

Catalogues

The Book of Dunns Farm Seeds, 1940. Pp. 56. (Salisbury: Dunns Farm Seeds, Ltd.)

The Nivoc Supplement. Special War issue, No. 2, February 1940. Pp. 16. (London and Birmingham: W. and J. George, Ltd.)

Catalogue of Books on British and Foreign Birds. (No. 647.) Pp. 16. (London: Francis Edwards, Ltd.)

Old Oil Paintings, Drawings and Prints. (Catalogue No. 281.) Pp. 34. Old and Modern Books of Various Sorts. (Catalogue No. 282.) Pp. 40. (London: Dulau and Co., Ltd.)

A Catalogue of Books on Africa, Australasia and America. No. 572.) Pp. 32. (London: Bernard Quaritch, Ltd.)

'Girl' Calendar, 1940–1941. (Manchester: Metropolitan-Vickers Electrical Co., Ltd.)

Prokayvit. Pp. 2. (London: The British Drug Houses, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 3, No. 24, March. Pp. 91–102+vi. (London: Wild-Barfield Electric Furnaces, Ltd.)

Boron in Agriculture. Pp. 36. (London: Boron Agricultural Bureau.)

Brush-Koela 'Duo-Draught' Gas Producer. Pp. 8. (Loughborough: Brush Electrical Engineering Co., Ltd.)

Bulletin and Laboratory Notes. Series 2, No. 10, March 1940. Pp. 20. (London: Baird and Tatlock (London), Ltd.)

Danger Signals. (Folder 119/40.) Pp. 10. (Coventry: Rotherham and Sons, Ltd.)

A Catalogue of Books and Periodicals on Astronomy, Chemistry, Electricity, Engineering, Mathematics, Mining, Physics, etc. (No. 573.) Pp. 36. (London: Bernard Quaritch, Ltd.)

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RESEARCH AND INVENTION IN UNIVERSITIES

UNIVERSITY authorities have for many years encouraged their staffs and students to do research work, the principal reason, especially applicable to the students, probably being that research is excellent educational training and therefore falls within the sphere of the primary activity of universities. A secondary reason, especially applicable to the staffs, is that research may produce results of great public benefit and is, to that extent, not inconsistent with the reason for existence of universities.

Research is, however, costly, and university authorities are not usually provided with funds on which there are not other demands, so that it becomes necessary either to obtain additional financial support or to limit the research. Although all kinds of research tend to grade into one another, it can be roughly divided into two classes, 'pure' research and 'applied' research, as is indeed indicated in the title of the "Department of Scientific and Industrial Research". While the mere publication of the results of any research may be of great public benefit, the direct financial reward thus obtained either by the research worker or by the university authorities is almost negligible. 'Pure' or 'scientific' research, however, differs from 'applied' or 'industrial' research, in that while there is no ready method of obtaining a direct financial reward for the results of pure or scientific research, applied or industrial research can generally be given a direct financial reward by means of the grant of a patent. A patent is granted for "any manner of new manufacture" in Great Britain, and, by enabling the patentee to prevent anyone else from using what is patented, confers on him the power to sell the right to manufacture it to any industrial organization willing to do so. By using the patent system in this way for the results of applied or industrial research, research workers and university authorities are able to obtain direct financial support from industrial organizations additional to any financial assistance given by Government or obtained in other ways. In all the great industrial countries, research workers and university authorities use their patent systems in this way, and the financial support thus obtained provides funds for the further encouragement of both classes of research. The methods by which different countries use their patent systems, however, have developed in different directions.

In Great Britain, university authorities have in general developed a method by which a professor is left entirely free to guide the research of his subordinate staff and the students under his care in the direction that he thinks best. He may feel that research in some particular line will give the students the best educational training or will afford the staff the best opportunity of conferring some public benefit, but in general he is left free to determine what, if any, use he will make of the patent system on the results of the research. Some professors merely publish the results made under their direction, while others take care to patent such results as seem likely to bring direct financial reward. In the former case the professor may feel that all the results of research should be freely dedicated to the public, and he may have, on this ground, an ethical objection to patenting any results. In the case of a professor who patents such results as seem likely to bring direct financial reward he may feel that by so doing he is ensuring that the greatest public benefit will be obtained, because, as is frequently pointed out, results of research dedicated to the public merely by publication are often most effectively withheld from the public since no one will assume the business risk and the development expense necessary to commercialize an article over which he can have no control for a reasonable period. If these results of applied or industrial research are patented, there is often an arrangement between the professor and some industrial organization giving the organization first claim on the commercial exploitation of the results in return for some financial reward and in some cases benefaction to the university.

The development in the universities in the United States of their methods of using their patent system was indicated recently by Mr. A. A. Potter, of Purdue University, in his address on "Research and Invention in Engineering Colleges" as vice-president of the Engineering Section of the American Association for the Advancement of Science. In preparing his address Mr. Potter states that he obtained information from thirty-nine universities and colleges, of which seven had organized research foundations for administering desirable patent policies, three others had entrusted the handling of their patent matters to the Research Corporation of New York, two others had given the responsibility for patent administration to a State board, and thirteen others had formed committees or boards to deal with their patent policies. About two thirds of the universities and colleges consulted had definite patent policies and these, it is pointed out, were the universities and colleges that received the greatest support from industry. Mr. Potter reports that "those Universities and Colleges which have definite patent policies are of the opinion that both the social and economic welfare of the public are being enhanced by their methods of handling patents and of encouraging creative activity of their staff members." In his opinion there is a definite trend for universities "to set up research foundations of their own, which finance research and to which the inventor assigns all rights of his research findings. Such institutional research foundations are non-profit corporations organized for the purpose of encouraging creative talent by relieving the inventor of the financial burden and loss of time from his research interests, and by financing research from profits accruing from the sale or royalty on patents."

In Germany, the policies of the universities with regard to patents have been generally more nearly allied to those of British universities rather than to those of American universities.

The great difference between the methods of using their patent systems developed in the American universities and in British universities is remarkable, when the similarity between their ideals is borne in mind. Whatever causes have contributed to this difference and however suited to the American mind may be the policies of their universities, it is certain that the policies of British universities are more suited to the character of the British people than would be the policies of the American universities. The personal freedom and the direct responsibility which the policies of British universities in general confer on their professors are characteristics which are not found to the same extent in American universities and which we should be loath to lose.

These characteristics, although general in British universities, are not universal, for in some cases British research workers are severely discouraged from patenting the results of their research—not infrequently with unfortunate consequences to themselves and the universities. A more tolerant attitude towards the British patent system, for example, by the controlling authorities in the research by British workers on the use of ultraviolet rays in preparing anti-rachitic products of foods and medicines, would undoubtedly have resulted in much greater credit being accorded to British research workers and in thousands of pounds being received by Great Britain from all parts of the world instead of being sent from this and other countries to the United States, as has, in fact, been the case ; and this is only one example of many.

It may well be that the safest course to follow in all research of which the results are likely to be of applied or industrial use is that the research worker should be free to apply for patent protection immediately he obtains his results, and should be encouraged to do so. If the results are of no commercial use little or no harm is done, but if they can be exploited commercially some industrial organization will place them on the market and so make them available to the public, the research worker will be given the credit of his results, and the beneficial owner of the patent, whether it be the research worker, the university, or others by contractual arrangement with them, will reap the financial reward.

NATURE IN THE CLASSICS

Nature in Greek Poetry
Studies partly Comparative. By Dr. George Soutar. (Published for St. Andrews University.) Pp. xix+258. (London: Oxford University Press, 1939.) 10*s*. 6*d*. net.

THE University of St. Andrews, which offered us three years ago the second and more complete edition of the monumental "Glossary of Greek Birds", by Sir D'Arcy Thompson (which I had the privilege to review in these columns), presents now to the lovers of classic literature another important work, by the late Dr. George Soutar.

Mr. J. C. Smith contributes a long biographical notice on the author. George Soutar entered the University of St. Andrews with a University Endowments Association bursary, which he bettered next year by winning a Bruce bursary. At college as at school his favourite subjects were English and Greek, and he was fortunate in his professors, Thomas Spencer Baynes and Lewis Campbell. Mathematics afflicted him, but in the humanities he proved one of the best men of his year: he was first in rhetoric and second in logic, Latin and Greek, and crowned his career in 1888 by graduating with first-class honours in classics. He won a prize for a poem on "Immortality", and this was not his only adventure in verse. St. Andrews gave him something even better than book-learning and the cultivation of the Muse; its small and friendly society gave a unique opportunity to his genius of friendship. His appointment as external examiner in English in 1896 made another link with St. Andrews for Soutar, and the connexion became permanent when in 1907 he was appointed to the staff of University College, Dundee, where, first as lecturer and after 1927 as reader in English, he served the University, until he retired in 1935. The official connexion did not end even then, for the University showed its gratitude by appointing him external examiner in English for a second time—an unusual compliment. The Senate designed yet another honour for him; they meant to present to him at the 1939 graduation the degree of LL.D.; but his death in February of that year frustrated their intention.

Soutar's students knew his great gifts as a teacher, but he published very little. The volume of selections from Pope and a "Book of Ballads", in collaboration with Mr. J. C. Smith, were all the books that appeared in his lifetime, although he also contributed two articles on Sir George Mackenzie and one on "Scot or Wyatt?" to the *Scots Magazine*. The present volume, the manuscript of which he left behind him, was his thesis for the doctorate of letters. He worked over it at intervals for a long time and until his death, remodelling it and enriching it as his knowledge of literature increased. Perhaps, we may assume, a few parts of the book waited for a finishing polish from the elegant pen of the author.

It is generally thought, and not without good reason, that classics of the purest period are not very keen about Nature, and, anyhow, that their rather short and occasional descriptions of Nature have an epigrammatic character.[*] They are mainly used, as, for example, by Homer, in comparisons with aspects of human life. So the famous image in the "Iliad":

> "The race of man is of the race of leaves:
> Of leaves, one generation by the wind
> Is scatter'd on the earth; another soon
> In spring's luxuriant verdure bursts to light.
> So with our race; these flourish, those decay."

Or the other lines, also from the "Iliad", the beauty of which ranks among the jewels of classical poetry:

> "As when in Heav'n, around the glitt'ring moon
> The stars shine bright amid the breathless air;
> And ev'ry crag, and ev'ry jutting peak
> Stands boldly forth, and ev'ry forest glade;
> Ev'n to the gates of Heav'n is open'd wide
> The boundless sky; shines each particular star
> Distinct; joy fills the gazing shepherd's heart.
> So bright, so thickly scatter'd o'er the plain,
> Before the walls of Troy, between the ships
> And Xanthus' stream, the Trojan watchfires
> blaz'd."

Homer's indifference to Nature is shown also, as Dr. Soutar remarks, by his lack of flower-sense. Although flowers are one of the outstanding beauties of Nature, not a single epithet of form or of colour is attached by him to any flower. Calypso's violets, the single and only mention of which in Homer makes Dr. Soutar exultant, are left uncharacterized by the poet. Crocuses and hyacinths form merely a bed "thick" and "soft"—πυκνὸν καὶ μαλακὸν. Homer makes no allusion to the fragrance of flowers. They are not spoken of sentimentally as associated with human joy or sorrow, not regarded as significant symbols.

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[*] Under the term "epigrammatic", I include all descriptive adjectives attributed by Homer to the sea, mountains, rivers or other natural features. Such epithets as "wine-dark" for the sea; "shadowy" for mountains; "deep-eddying", or "beautifully-flowing", for rivers; and "starry" for the firmament; all of them give but a flashing glimpse of the object, they do not constitute descriptions in the strict sense of the word.

Dr. Soutar consoles himself for this lack of flower-sense in Homer when he finds in the "Odyssey" (Book VII, 112–113) the luxurious description of King Alcinoüs' garden at the side of his palace. He gives a translation of his own of the passage, in prose, but I prefer to quote it here in the lines of Cowper:

"A spacious garden lay, fenced all around
Secure, four acres measuring complete.
There grew luxuriant many a lofty tree,
Pomegranate, pear, the apple blushing bright,
The honied fig, and unctuous olive smooth.
Those fruits, nor winter's cold nor summer's heat
Fear ever, fail not, wither not, but hang
Perennial, whose unceasing zephyr breathes
Gently on all, enlarging these, and those
Maturing genial; in an endless course
Pears after pears to full dimensions swell,
Figs follow figs, grapes clust'ring grow again
Where clusters grew, and (ev'ry apple stript)
The boughs soon tempt the gath'rer as before.
There too, well-rooted, and of fruit profuse,
His vineyard grows; part wide-extended, basks,
In the sun's beams; the arid level glows;
In part they gather, and in part they tread
The wine-press, while, before the eye, the grapes
Here put their blossom forth, there gather fast
Their blackness. On the garden's verge extreme
Flow'rs of all hues smile all the year, arranged
With neatest art judicious, and amid
The lovely scene two fountains welling forth,
One visits, into ev'ry part diffus'd,
The garden-ground, the other soft beneath
The threshold steals into the palace-court,
Whence ev'ry citizen his vase supplies.
Such were the ample blessings on the house
Of King Alcinoüs by the Gods bestow'd."

Unfortunately, this description is considered as spurious, a mere interpolation by a writer much more modern than the Homeric era, and of a period when romanticism invaded literature, superseding the naked simplicity of classical poetry, and it indulged in mellifluous evocations. As a matter of fact, it is remarked by one of the most learned commentators and editors of the "Odyssey", the late Victor Berard, that the existence of such a large garden, occupying an entire acre (because Cowper is mistaken in his translation of the Homeric area as implying four acres), in which the royal palace was situated is impossible. The excavations at Mycenae, Tiryns and elsewhere, prove convincingly that the enclosures containing the royal mansions, though strong enough for protection, were too small for a garden and orchard as described in the above lines.

Still, Dr. Soutar could stick for a genuine description of Nature in Homer to the few lovely lines in which his beloved, though uncharacterized violet flourished. May I be allowed to quote it here, again from Cowper's translation of the "Odyssey" (Book V, 68–74):

". . . a grove on either side,
Alder and poplar, and the redolent branch
Wide-spread of Cypress, skirted dark the cave.
There many a bird of broadest pinion built
Secure her nest, the owl, the kite, and daw
Long-tongued, frequenter of the sandy shores.
A garden-vine luxuriant on all sides
Mantled the spacious cavern, cluster hung
Profuse; four fountains of serenest lymph
Their sinuous course pursuing side by side,
Stray'd all around, and ev'ry where appear'd
Meadows of softest verdure, purpled o'er
With violets; it was a scene to fill
A God from Heav'n with wonder and delight."

Leaving Homer, Dr. Soutar proceeds to the study of other poets. The Hesiodic poems, he says, are almost destitute of flowers. They are only mentioned in the garland put by Athena on the head of the maiden, "the beautiful evil" formed by Hephæstus ("Theog.", 576). Still this is not a description of Nature but only of an ornament. Archilochus is the first to mention "the fair flower of the rose-bush"—ῥοδῆς τε καλὸν ἄνθος, but the mere mention of the rose, with the simple epithet *kalon* (pretty), does not show, I think, much enthusiasm for the queen of flowers. We must reach the era of decadent poets of the "Anthology" and to Anacreon to find praise worthy of the subject. The epithet ἰοστέφανος, so well known later, is applied to Aphrodite in Solon and to the Muses in Theognis. To find something specifically and purely connected with flowers, Dr. Soutar rightly has recourse to the lovely choral song in "Œdipus at Colonus", where Sophocles extols the wooded hill near Athens:

"Thou hast come to a steed-famed land for rest,
 O stranger worn with toil,
To a land of all lands the goodliest
 Colonus' glistening soil.
'Tis the haunt of the clear-voiced nightingale,
 Who hid in her bower, among
The wine-dark ivy that wreathes the vale,
 Trilleth her ceaseless song;
And she loves, where the clustering berries nod
 O'er a sunless, windless glade,
The spot by no mortal footstep trod,
 The pleasance kept for the Bacchic god,
Where he holds each night his revels wild
With the nymphs who fostered the lusty child.

"And fed each morn by the pearly dew
 The starred narcissi shine,
And a wreath with the crocus' golden hue
 For the Mother and Daughter twine.
And never the sleepless fountains cease
 That feed Cephisus' stream,
But they swell earth's bosom with quick increase,
 And their wave hath a crystal gleam.
And the Muses' quire will never disdain
To visit this heaven-favoured plain,
Nor the Cyprian queen of the golden rein."

Another early classical fragment, the famous tetrastich by Sappho, in which the poetess laments her lonely night, is quoted too by Dr. Soutar as a description of nocturnal skies, when moon and Pleiads are set, as an evocation of Nature. But let us read the poem in the high-sounding music of its Doric idiom and we will see that it has little to do with moonlight and stars and much more with the despair of a soul—the incandescent soul of the poetess. Here is its rendering, but how inferior it looks to the original, how cold it is to the flame burning throughout the Greek lines :

> "The moon is gone—And the Pleiads set,
> midnight is nigh—Time passes on, and passes—
> yet alone I lie down."

Those who can read Greek must take and recite the original aloud.* They will realize then the inimitable beauty of these four lines crying the desolation of a heart, insatiable of exaltation.

In spite of other examples and ample quotations in the book, the impression persists that mere descriptions of Nature and for the sake of Nature itself are rare in earlier and purely classical poets. The love of Nature instead becomes a more general feeling among post-classical poetry. There are striking examples of it, such as the lovely poem to the Cicala from Anacreon (which it should not be forgotten is the composition of some Alexandrian imitators, as Anacreon's work itself is entirely lost to us), with its charming first ten tines :

> "Drunken with a drop of dew,
> Happy, happy as a king,
> We can hear thee twittering ;
> Everything within thy view
> From the tree-top, in the fields,
> Everything each season yields,
> O cicala, is thy dower ;
> Dear to everyone thou art,
> Dearest to the farmer's heart,
> Prophet sweet of summer's hour !"

Instead, I do not really find descriptions of Nature in some translations from Greek poetry printed at the beginning of the book. The "Fishermen", from Theocritus, the fragments from the Second "Olympian" Ode of Pindar, an unspecified fragment from Euripides, and the "Lament for Adonis", from Bion, seem to have a rather remote connexion with Nature, and they are probably published here to show Dr. Soutar's ability for rhymed translations from the Greek, as in the absence of any contrary indication, I must presume that the rendering of these fragments are from his own pen.

If the chapter on the Greek anthology, which concludes the book, was not one of the two to which we understand the author had not the time to add the last touches, was to be adequately completed, how welcome would be in regard to the purpose of the book the reproduction of the charming description of the Grove by the River Iris, probably by Marianus Scholasticus, so felicitously rendered by A. J. Butler in his little volume "Amaranth and Asphodel" :

> "This is the grove of Love, whose leafy bowers
> Are rustling to the west-wind's gentle sound,
> Where all the dewy mead is set with flowers
> That lift their azure glory from the ground.
> Here from three ledges on the hillock springs
> A brook by fountain-nymphs shot down the glade,
> While through yon copse the ancient Iris swings,
> And soft-haired wood-nymphs court the noontide shade.
> Here goodly olives, here the clusters twine
> And hang their fruit above the sunny floor ;
> Around to warbling nightingales divine
> Cicalas quire and answering music pour.
> Enter my home and share my lowly cheer."

Here, indeed, "when the Hellene", according to Dr. Soutar's own happy expressions, "has become a Hellenist, and he has drunk of the wine of the Orient, he undergoes a change in feeling, colouring his conception of external Nature with a more sensuous and subjective treatment".

It is to be regretted that in such a scholarly book some not unimportant omissions occur. The occasional reader, for example, will look in vain for many of the Greek quotations to be followed by a translation. The reader, with even a moderate classical training or a remnant of reminiscences of his Greek studies, will enjoy such quotations even if he is compelled to consult from time to time his Liddell and Scott. The outsider, however, will stop in despair at many passages, wondering what they mean and to what extent the author is justified in quoting them as characteristic in the scope of his work. Other fragments are published only in their English translation, not rarely without the respective reference to the original. The lack of an index constitutes also a drawback, fortunately so rare in English books, which, treasured after a first reading, may be enjoyed again and again in hours of need of comfort or relaxation, when some particular passage has left in the memory a faint scent, which one loves to inhale once more.

In spite of such reservations as the above, I loved the book and enjoyed it immensely. Many readers in their turn will delight in the fragrance of the flowers of this *Florilegium*, gathered and arranged by an expert hand into a bouquet of beauty and charm.

The printing of the Oxford University Press is, as always, irreproachable.

Demetrius Caclamanos.

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*The poem in the original Greek is printed here for them who would or could follow my advice.

δέδυκε μὲν ἀ σελάννα
καὶ Πληϊαδες - μέσαι δὲ
νύκτες, πάρα δ᾽ἔρχετ᾽ὤρα -
ἔγω δὲ μόνα κατεύδω ÷

ROCK METAMORPHISM

Metamorphism.
A Study of the Transformations of Rock-Masses. By Dr. Alfred Harker. Second edition, revised. Pp. x + 362. (London: Methuen and Co., Ltd., 1939.) 21*s*. net.

THE first edition of this book appeared in 1932. Dr. Harker had completed the revision of the text of this second edition only a few weeks before his death, which took place in July 1939. The modifications appearing in the new edition are chiefly minor changes, usually limited to a few words each, leading to certain clarifications. In addition, references to some of the work which has appeared between 1932 and 1939 are given, but little new matter is incorporated in the text. Among the more important alterations are the following: the cordierite-anthophyllite rocks of Kenidjack, Cornwall, are now considered with Eskola's Orijarvi analogues in the chapter dealing with pneumatolysis and metasomatism; brief mention is made of recent experiments by Bridgman and Larsen on stress effects; the inhibition of reactions through the presence of carbonaceous material, a notion rather frowned upon in the first edition, is now admitted to be possible; there are certain additional remarks on the Inchbae aureole, adinoles, the oligoclase zone, eclogites, etc. The book thus remains essentially unchanged.

In its own field, Harker's "Metamorphism" is a masterpiece. It presents the essentially British contributions to the study of the metamorphic rocks, chief among these being Barrow's zonal work, and the notion of rock metamorphism as a series of progressive changes in response to changes of external conditions. Harker's presentation is reinforced by a wealth of personal observations and by perfect lucidity of expression. The book remains as a magnificent monument to Harker and his generation.

It is not ungenerous to suggest, however, that the field covered by Harker is a very restricted one, and that his outlook was essentially conservative. These facts should be realized by British students in particular, who should take this book as a partial and personal statement. There are wide realms of investigation in metamorphism that were scarcely touched upon by Harker. Such topics as migmatization and its relation to metamorphism, petrofabrics, the importance of metasomatic processes and so forth are not dealt with, and yet it is along these lines that future progress in the study of British metamorphic rocks is likely to develop. Once the limitations of Harker's treatment are realized, however, his work can be used as a sure foundation for British metamorphic geology—a foundation not possessed by field-workers in other countries. Upon this firm base can be built all the more securely the future edifice of British contributions to the development of metamorphic studies.

H. H. READ.

THE CHEMICAL BOND

The Nature of the Chemical Bond and the Structure of Molecules and Crystals
An Introduction to Modern Structural Chemistry. By Prof. Linus Pauling. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Pp. xiv + 429. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1939.) 21*s*. net.

SINCE G. N. Lewis's fundamental paper of 1916, the electronic theory of valency has been amplified and applied so extensively as to create the need for a monograph every few years; and every few years, so far, a monograph has been produced by a leading contributor to the subject. Lewis's own book "Valence and the Structure of Atoms and Molecules" (1923), Sidgwick's "Electronic Theory of Valency" (1927), and his "Covalent Link in Chemistry" (1933), set a high standard, and the present volume is a worthy successor.

In it the author discusses the nature of chemical combination in both molecules and crystalline aggregates. The treatment is based on the electronic theory of valency as rationalized and extended by quantum mechanics, special emphasis being laid on the resonance phenomenon. The fundamental types of combination are discussed very thoroughly. The one-, two-, and three-electron bonds are considered as involving resonance between alternative electron assignments among the bonded atoms. The directed bonds in polyvalent atoms involve additional resonance among the *s*- and *p*- or *s*-, *p*- and *d*-orbitals of the polyvalent atom. Bonds of partially ionic character are represented as resonance between electron assignments corresponding to electrostatic and co-valent (2-electron) bonds. Metallic bonds are described in terms of resonance between alternative positions for one- and two-electron bonds. Finally, the specially important case of "resonance of molecules among several valence bond structures" (or mesomerism) is described and extensively illustrated.

No mathematics is introduced, conclusions which can be justified or made plausible only by arguments more or less mathematical in nature being stated without proof. The method of treatment is an excellent one for enabling much ground to be covered in a short space, and is a procedure that is wholly justified for the author, who (with E. B. Wilson) has already produced a first-class text of chemical quantum mechanics; but the reviewer hopes that a study of the more cursory treatment in the present text will not be regarded as an adequate alternative to an acquaintance with the elementary ideas of quantum mechanics as a foundation for the theory of the atom and of valency. More might have been written, for example, of the subjective nature of resonance, as shown by the general character of the variation theorem, or, more remotely, by the subjective aspect of much of quantal philosophy. The difficulties illustrated would be cured if readers of the book could be persuaded to read Prof. Pauling's other book, and his original papers, especially those which form the basis of the present work and were published under an identical title.

On the experimental side, one of the most valuable features of this work is the large extent to which it co-ordinates the mass of information that has in recent years accrued from the various physical methods of investigating molecular structure. The tables of ionic radii, bond lengths, valency angles, bond energies, etc., alone would be important, but they are made much more so by the synthetic and suggestive manner in which they are presented and discussed. Alike in this field and in the theory, the book is in large measure a record of Prof. Pauling's personal contributions, and it will be assured of as permanent a place as its three predecessors in the contemporary history of chemical science.

C. K. Ingold.

THE STUDY OF HANDWRITING

Analysis of Handwriting
An Introduction into Scientific Graphology. By H. J. Jacoby. Pp. 286+27 plates. (London: George Allen and Unwin, Ltd., 1939.) 10*s*. 6*d*. net.

HANDWRITING is obviously a form of individual expression by hand gesture; no two children who have been taught to write from the same copy and even by the same teacher will ultimately develop identical handwritings. The differences in handwriting must, therefore, be due to personal characteristics—manual, æsthetic, emotional or intellectual—of the writers themselves.

The author makes no attempt to investigate the pictographic origin of writing, or to link it to other forms of expression by gesture, or with precision (or the reverse) in articulation—with which, in particular, handwriting might be expected to be associated. He claims that handwriting is significant of the writer's "general manner of working". But this, though possibly true as to craftsmanship, might not be true of other forms of work. Some very able individuals are notoriously 'butter-fingered'.

Many of the author's conclusions will be readily accepted, for example, that in handwriting, good spacing and regularity indicate orderliness and self-discipline: that exaggeratedly large writing denotes love of display, and that small and precise handwriting implies an unemotional or pedantic nature. Other dicta, such as that convex curves (arcades) indicate "shutting to the outside world", or that movements to the right manifest tendency towards the outside world (and *vice versa*) need further proof.

The book would be easier to read if the 161 illustrations—which are well reproduced—were more systematically related to the descriptive text. Fewer illustrations, more carefully chosen, would have been better. The index, too, could have been improved by additional headings.

The author claims for 'graphology' a high percentage (87–95 per cent) of correct judgments as to character, psychological condition, ability, etc. To check this claim, the Institute of Industrial Psychology, for example, might provide Mr. Jacoby with specimens of the handwriting of a number of cases examined by them, so that the correlation between the findings of graphology and of psychological analysis might be measured.

This book is certainly interesting, though somewhat discursively written.

R. A. S. Paget.

INFRA-RED SPECTRA AND THE STRUCTURE OF MOLECULES*

BY DR. W. H. J. CHILDS AND DR. H. A. JAHN,
ROYAL INSTITUTION, LONDON

WE have to go back only to 1800, to W. Herschel's discovery that beyond the red end of the sun's prismatic spectrum there is something capable of warming the bulb of a thermometer, to find the germ of a method which, through its contributions to our knowledge of molecular structure, is beginning to be of much importance both to chemistry and to physics. Herschel's discovery was accompanied by an error—that the energy maximum of the spectrum lay also outside the red—though this probably made it even more effective in stimulating the curiosity and imagination of contemporary men of science. In spite of this interest, for the rest of the century progress was slow, and this period is taken up first with the need of proving that the new rays are nothing other than invisible light and obey exactly the same laws; and then with the task of mapping the new region, to find out if and how the radiation is absorbed by matter.

On looking back, we see that the real advances are the improvements in technique, mainly concerned with increasing the sensitivity of radiation detectors. Towering above all in its effect was the discovery by Rowland of a method of making a perfect screw, and with it constructing the concave diffraction grating. These technical advances have made their permanent impression, and we find to-day that the thermopile and the diffraction grating in their modern improved forms are playing a leading part in infra-red research. At the beginning of the twentieth century, though many absorption spectra in the region 1–20 μ had been measured and it was known that every substance, with the exception of the diatomic homopolar molecules such as hydrogen and nitrogen had characteristic absorption bands in the infra-red, no success had attended the few attempts empirically to systematize this knowledge. Indeed it is only in recent years, following upon the successful disentangling of the spectra of diatomic molecules with the help of quantum theory, that infra-red absorption bands are being related to other molecular magnitudes.

The starting point of the theoretical interpretation of infra-red molecular absorption bands is the Faraday-Maxwell electromagnetic theory of radiation. Once it was clear that radiation consists of electrical oscillations, the absorption of infra-red radiation by molecules could be explained on the basis of resonance between the electrical oscillations of the individual molecules and the oscillations of the electromagnetic field. The occurrence of characteristic frequencies in the absorption spectrum pointed to the existence of a definite spectrum of frequencies possessed by, and characteristic of, each individual molecule, this again pointing to a definite mass distribution and force system in the molecule.

Before Rutherford's nuclear theory of the atom, however, very vague ideas were current about the distribution of mass in the molecule. Molecules were considered to be built up of spherical ions, and characteristic frequencies of the individual ions were often spoken of, as would be possible if there were a characteristic distribution of mass in the ion itself. With the advent of Rutherford's theory, the distinction was quickly made between electronic frequencies involving the electronic mass, and the much slower frequencies involving the nuclear masses. It is these latter frequencies which show up in the infra-red absorption bands. Thus, for example, the water molecule is to be regarded as consisting of three heavy mass points held together in their equilibrium positions by electrical forces. It is easy to see that such a mechanical system possesses three degrees of vibrational freedom, so that the water molecule should have (as is indeed the case) three different molecular frequencies showing up in its absorption spectrum. It was this clarification of the situation that enabled Bjerrum in 1914 to lay the foundations of the method of calculating molecular frequencies still in use to-day. It had been pointed out still earlier by Lord Rayleigh that if the electrical oscillations have definite fixed directions in the molecule, then the rotational frequencies of the molecule will also appear in the spectrum, since the carrying round of the fixed electrical oscillation by the molecule will be equivalent to a harmonic oscillation having the same period as the molecular rotation, which will thus appear combined with the vibrational frequencies in the spectrum.

For the purposes of review, we may conveniently separate infra-red spectrographs into two classes, low resolving power prism and high resolving power grating instruments. The prism spectrograph is adequate to measure band envelopes, but for the finer structure due to molecular rotation, and to separate overlapping bands in the 3 μ region, and above all for work in the very long wave infra-red in the region 30–100 μ, a grating instrument is essential. Thus these two classes, very broadly speaking, give us respectively information about molecular forces and molecular sizes. The prism spectrograph has usually a theoretical resolving power of some few hundreds, but this is reduced when in use (the need of using slits wider than the optimum is one reason) by a factor of from four to eight. There have been advances in design in recent years. Careful placing of the entrance and exit mirrors of the prism, so that the errors introduced into the beam by one are partially rectified by the other, has resulted in much improved definition in the spectrum falling on the exit slit. There is a noticeable tendency to place the whole spectrograph in an evacuated chamber, thus avoiding the loss of energy in those regions of the spectrum where strong absorption by the water vapour and carbon dioxide of the atmosphere occurs. For the prism and windows we are no longer dependent on natural crystals of rocksalt, as large enough crystals can now be grown from the melt. Crystalline potassium bromide obtained in this way has extended the range of prism instruments to nearly 30 μ.

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*Substance of a course of seven lectures delivered at the Royal Institution between November 3 and December 15, 1939.

Subsidiary apparatus has also been improved. Thermopiles with only one or two elements are constructed to have a resistance and speed of response to match the galvanometers with which they are to be used. The moving-magnet galvanometer has gone quite out of favour, and is replaced by a less sensitive but far more stable moving-coil instrument, connected by some form of photoelectric or thermo-electric amplifier to a second more rugged galvanometer from which the readings are taken. In some instances where careful design and construction have almost entirely eliminated disturbances and drifts, it has proved worth while to instal an automatic recorder.

With grating instruments the resolving power is usually of the order of several thousands, and although in practice the necessity of using slits wider than the optimum again sets the limit, nevertheless powers of 10,000 at 3 μ, and 300 at 80 μ, have been attained. The predominant type of grating is the 'echelette', with a predetermined groove-form to diffract the bulk of the energy in one particular direction. This property is a most desirable one, for the energy available is usually so meagre that its dissipation into spectra of more than one order cannot be tolerated. If it is desired to work in more than one region, several gratings must be employed, those for the longer wave-lengths having correspondingly wider grooves and thus, for the same resolving power, greater dimensions. Excellent gratings as large as ten inches by twenty inches have been produced for work at the longest wave-lengths, around 80 μ. The suppression of other orders and the scattered radiation of the more abundant shorter wave-lengths around 3 μ, which would so to speak 'fog' the thermopile, is achieved with judiciously selected filters, or by making use of selective *reststrahlen* reflections, or by a combination of both.

By using vacuum thermopiles, carefully screened conductors and evacuated spectrographs, disturbances and drifts are reduced to a minimum, but even so, automatic recording is not possible in the longer wave-length regions unless a special tuned amplifier is used. With this ingenious device the beam of infra-red radiation is interrupted periodically by a shutter so that the deflection of the primary galvanometer is also periodic. The amplifier is tuned to the same frequency and is thus insensitive to drifts and all disturbances of arbitrary period. The deflections of the secondary galvanometer may then be recorded photographically, since its zero remains steady.

It is possible to make measurements in the very short-wave infra-red, from the visible to 1·2 μ, with ordinary diffraction gratings and the specially sensitized photographic plates which are now commercially obtainable. The resolving power may be high, of the order of 20,000, but the relatively simple technique is unfortunately limited to a few types of bands of molecules containing hydrogen. In these cases alone is the absorption great enough to permit the use of absorption tubes of practical length.

The theoretical analysis of molecular infra-red absorption bands can be divided into two fairly distinct processes: the vibrational and the rotational analysis. This division follows quite closely the division of the experimental work into prism and grating spectroscopy respectively.

In the vibrational analysis we consider the molecule to be built up of point masses (the atomic nuclei) held together by elastic forces, and the major problem is to calculate the classical normal modes of vibration of such a system. Such a calculation necessitates a knowledge of the equilibrium configuration of the molecule and a knowledge of the elastic forces which are called into play when the atoms are displaced from their equilibrium positions. The geometrical configuration is usually fairly well established from chemical considerations or from the electron theory of valency, whilst the force system also in many cases goes hand in hand with the chemical formulæ. Thus a good part of the vibrational spectrum can be interpreted on the basis of characteristic stretching constants for the individual chemical bonds. A molecule possesses, however, in addition to such valency vibrations, deformation modes in which only the angles between chemical bonds change. It is tempting to introduce individual characteristic elastic constants for the angles between the bonds, but such a procedure is beset with pitfalls. A good example of the difficulties involved is the calculation of the deformation frequencies of the acetylene molecule. If a simple potential is assumed, involving only such characteristic angle constants, one obtains a false assignment of the fundamental frequencies which can only be avoided by taking into account a term in the potential energy which couples the two angle oscillators. The importance of such coupling terms has often been overlooked in calculations of the low-frequency fundamentals of molecules.

The calculation of the fundamental frequencies of even relatively simple molecules is a lengthy and tedious business, which can, however, be greatly shortened by making proper use of the symmetry of the equilibrium configuration of the molecule. There is further a general theorem due to Teller and to Redlich, which enables one to obtain useful results about the frequencies of isotopic molecules without making detailed calculations. This theorem is based on the fact that the vibrational or reduced mass of a normal mode can be expressed in the form of the product of the individual atomic masses divided by the total mass of the molecule and its moments of inertia, these latter entering only if the vibration has the same symmetry respectively as a translation or infinitesimal rotation of the molecule. Since an isotopic substitution of hydrogen by deuterium does not change the potential, the effect on the frequencies is determined solely by the change in the reduced mass. Thus from the form of the vibrational mass the ratio of the products of frequencies of isotopic molecules can be deduced. The agreement is never perfect, owing to the fact that the observed frequencies require correction for the anharmonicity of the vibrations, but this general product theorem has been of great value in checking the assignments of frequencies without making lengthy calculations.

The rotational analysis is a much more involved problem than the vibrational analysis. This is due not only to the fact that a definite spectrum of rotational frequencies is an idea quite foreign to classical theory and can be explained only on the basis of quantum kinematics, but also to the classical effect that internal vibrations in a rotating mechanical system give rise to Coriolis or vibrational-gyroscopic forces which greatly modify the rotational motion. The Coriolis forces as well as the simple centrifugal forces depend upon the nature of the vibrational potential, so that we obtain perturbations of the rotational structure of the absorption bands which depend upon the characteristic vibrational potential of the molecule. Thus whilst the simple theory of rigid rotating molecules leads to a classification of rotational spectra into those of spherical, symmetrical and asymmetrical top molecules, according to the nature of the ellipsoid of inertia, the exact theory requires a separate treatment for each individual molecule. A glance at recent work of this nature suffices to show that the quantum dynamical considerations involved are as thorough as any that have been necessary in the interpretation of the finer details of atomic theory. Whilst this complication might on one hand be regretted, it is on the other hand very satisfactory that the technical progress of experimental infra-red investigation has been so rapid that this branch of science will soon take equal rank with the sister science of atomic spectroscopy.

Although the advance in recent years has been so rapid, there is much more remaining to be done. The paucity of energy for wave-lengths greater than about 10 μ in the spectra of heated bodies has been a factor which from the very beginning has retarded development. The technique, like any other concerned with the measurement of small quantities, is a difficult one, so that even to-day, in spite of the great potential importance of measurements in the infra-red both to pure science and to industry, the number of schools engaged in breaking new ground is very small. To this situation must be added the neglect of the commercial instrument maker which, though natural enough in the circumstances, means that every worker who wishes to be abreast of developments must be something of a precision instrument maker as well. Any improvement in design or technique which would enable measurements to be made with the same speed, reliability and ease with which they are made with photographic spectrographs would be an advance of the first magnitude.

An attack in this direction which promises well is the evaporograph, in which the spectrum is received on the blackened face of an extremely thin celluloid film, the reverse face of which is covered by a layer of oil molecules in equilibrium with the vapour phase. The minute differences of temperature caused by the energy variations in the spectrum produce changes in the thickness of the oil layer, which show up when its interference pattern is photographed with blue or ultra-violet light.

In a review as short as this, applications can be only briefly indicated. For industry, important advantages are, first, that a sample may be examined without destroying or indeed interfering with it, and that very small quantities are required, and secondly, that since the spectrum between, let us say, 1 μ and 30 is a unique property of any given substance, that spectrum may in principle be used to identify the substance in any mixture in which it remains unaltered. In favourable cases concentrations as low as 1 in 10,000 may be recognized. If the substance is modified in the mixture, by association or otherwise, then its spectrum reflects the change and may be used as a source of information about it. So far as pure science is concerned, the greatest application of infra-red research in the near future will probably be made in conjunction with isotope chemistry, at first with deutero-substituted compounds, but later with other isotopes, carbon, nitrogen and oxygen in particular, as fast as they are made available in quantity. With this technique a knowledge of reaction mechanisms will be obtained which would scarcely be possible by any other method.

THE FENLAND*

By Prof. J. Stanley Gardiner, F.R.S.

THE Fenland is an area of 73 miles by 36 miles, covering 1306 square miles, and comprises parts of the counties of Lincoln, Norfolk, Suffolk, Cambridge, Huntingdon and Northampton. It consists of Jurassic clays underlying glacial boulder clay, cut into basins and water courses by tidal and river actions. Some Jurassic islands were left, such as Ely, while peat formed in the swamps to the south, merging into a broad belt of silt against the sea. The area was not stable, and peat and silt in places alternate ; and often horizons of submerged forests are followed by swamp conditions. In the earliest period of history the Fenland was a flat expanse with scattered islands and ridges from the surrounding uplands, all these cultivated, while the swamps yielded rough produce for stock, the streams abundant fish, especially eels, and the marshes wild-fowl. Of course it must have been a paradise to the Romans by providing an outlet for their energies, the results of which are problematical. It is only certain that there was wide cultivation succeeded by decay. This was possibly due to the neglect of drainage works, complicated by a small change in land-level in progress towards the termination of the Roman occupation.

In the Norman period the condition of the Fenland may be inferred from the map of the Domesday settlements. It must have been affected by the relatively recent monastic foundations of Crowland, Ely, Ramsay, Thorney and Chatteris. For his recently issued studies on the Fenland, Mr. Darby has consulted all authorities, but they have helped little as to the economy in this Anglo-Danish period. His inferences are based on the Domesday settlement—peat lands do not allow of the building of house foundations—the sizes of parishes and the distributions of fisheries, salt pans, meadow and other lands. The Wisbech estuary now became silted up and inundations followed. At some uncertain date the Eastern and Western Ouses were diverted, partly by artificial channels, to reach the sea at Lynn. Traffic to the surrounding lands apparently thronged the waterways. In the fourteenth century the Fenland was many times more prosperous than the surrounding upland. Strategically, it might be a centre of rebellion or of refuge—a comparison with part of southern Finland to-day is not inappropriate—but disturbances were largely dictated by neighbouring barons. Socially, there was no isolation and its people were not "endowed with any qualities of desperate wildness extracted by some mystical influence from reeds and rushes". Mr. Darby's economic study of this time is excellent, but he could have made it plainer to his readers had he presented a picture of the Fenland as it really was, its meandering rivers, open pools, marshes, sedge and litter lands, thickets and woods. Its peat is not the well-known product of moss but of the decay of sedge and litter ; it is very alkaline.

The account of Tudor times in the Fens reveals a woeful condition of dire poverty. This was partially due to the upheaval that succeeded the dissolution of the monasteries, but every 'Court' was quite ineffective in maintaining the Fenland channels and drains. Parliament became interested in the matter and in 1534 passed the first Act for the preservation of birds ; wild-fowl were given a close season in June, July and August, and the taking of their eggs was prohibited "upon pain of imprisonment for one year". Later, there were great floods and many permanent 'drownings', and in 1570 the sea broke in near Wisbech. Drainage thus became a matter of national rather than parochial interest, the first effort being concentrated on cleaning out the channels and repairing the banks near Wisbech.

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* The Medieval Fenland. By H. C. Darby. (Cambridge Studies in Economic History). Pp. xvii+200+11 plates. (Cambridge: At the University Press, 1940). 12s. 6d. net.

The Draining of the Fens. By H. C. Darby. (Cambridge Studies in Economic History). Pp. xix+312+31 plates. (Cambridge: At the University Press, 1940). 21s. net.

The interest of King James resulted in a welter of ineffective activity. In 1630 the Earl of Bedford 'adventured' his money to drain the southern fens, now known as the Bedford Level. He employed that Vermuyden whom the Commissioners had previously refused to employ. His plan was to shorten the courses of the main streams so as to increase their gradients, erecting the necessary sluices to control the tides. In 1631 the Bedford River, a straight channel 21 miles long from Earith to Denver, was dug; it was completed twenty years later by a strongly embanked second channel. I may say that in the nineteenth century it attained peculiar fame, for here a great controversy as to the rotundity of the earth was settled by A. R. Wallace (see NATURE, April 6, p. 561).

Other projects were a "Middle Level" from Peterborough and a "Northern Cut"; the Earl of Lindsey was at work on the Lincoln fens. Everywhere there were disturbances as the whole economy of the region was upset, and "Mr. Cromwell" appeared at Huntingdon in 1638 as the chief opponent of King Charles, who was the "undertaker". Later Cromwell established himself at Ely, so that in the Civil War the Fens were not a harbour of refuge; of course all work ceased and there was much destruction. Internal peace encouraged a resumption of drainage in the southern Fenland, and Cromwell, now the statesman and great patriot, supplied both Scottish and Danish prisoners as labour; German prisoners were used similarly in 1917–18.

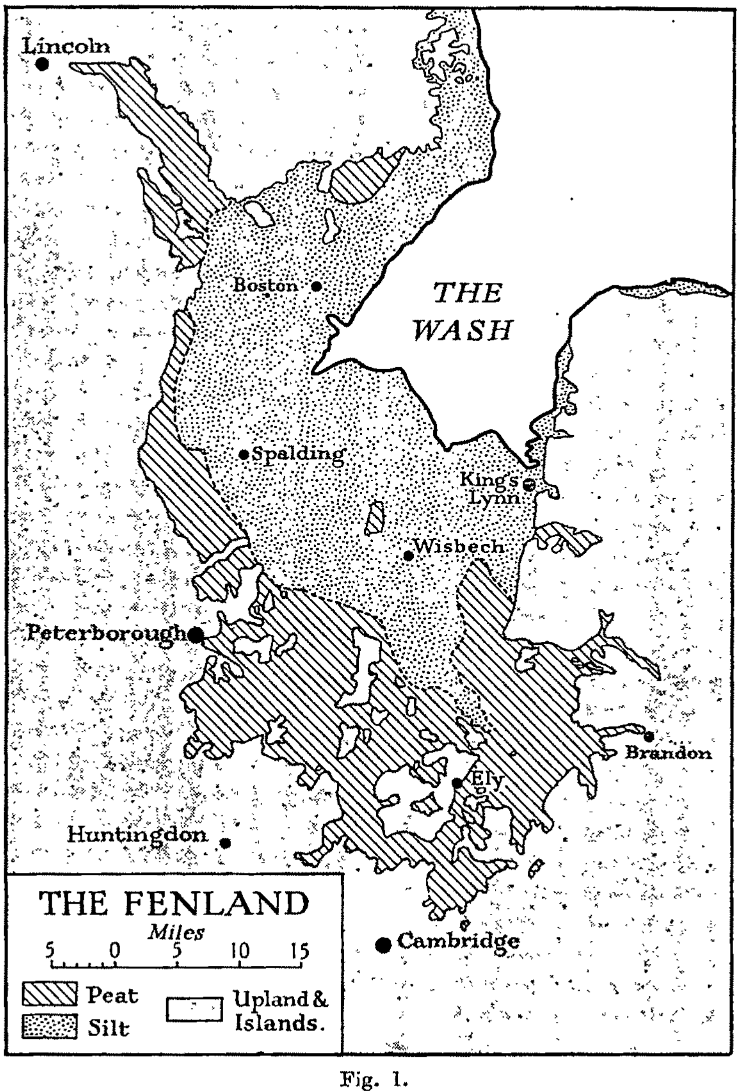

Fig. 1.
FROM "THE MEDIEVAL FENLAND".
THE PRESENT-DAY DISTRIBUTION OF THE LAND.

Innumerable difficulties were experienced in the eighteenth century due to the necessity of preserving channels for navigation, the inefficiency of the control of the outfalls to the sea, the looseness of the banks—this allowed a constant seepage—and, above all, the settling of the ground surface in the peat lands. The latter now lay considerably below the river-levels and the water channels that had been cut to carry the upland drainage into the rivers. Such shrinkage was experienced but slightly over the silt lands of Lincolnshire, so that the problems there were never so difficult as over the southern Fenland. For example, Wicken Sedge Fen is a catchment basin for the waters of its adjoining uplands, which are retained by means of the lodes and ditches surrounding it, while the surface of the peat lands of the neighbouring Burwell Fen now lies 7 ft. below, this difference representing the shrinkage*.

Nearer the centre of the Fenland in 1851 a column was inserted near Whittlesea Mere to the level of the peat surface. The mere was pumped by the new Appold system, and in three weeks 1,000 acres almost 3 ft. deep were drained; the column now stands 11 ft. above the surface of the ground, and there is 11 ft. of peat below. "The better the drainage, the greater the wastage of the peat surface", as Darby expresses it. A remedy was found ; the picturesque wooden windmills being built in the eighteenth century replaced ponies in raising the water from ditches in the lower Fenlands to the drainage lodes, which were straightened still more and strengthened ; the outfalls with the necessary sluices were likewise improved.

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* "On the Level of the Fens around Wicken", by W. S. Farren, "Natural History of Wicken Fen", 190 *et seq* (1926). This is the part of the Fenland which best retains the conditions preceding the drainage. The vegetation is considered by Messrs. Godwin and Tansley, and the animal life by Dr. A. H. Evans and more than thirty other authors. These volumes have escaped Mr. Darby's bibliography.

Even at the end of the eighteenth century, conditions in respect to flooding were bad, as Young tells us, but the reclaimed land was the richest in England for corn and stock. Only a few years later the advent of the steam engine gave man the necessary power of control. An inscription on a pumping station of the New Bedford River reads :

These *Fens* have oft times been by *Water* drown'd,
Science a remedy in *Water* found.
The powers of *Steam* she said shall be employed
And the *Destroyer* by *Itself* destroyed.

Owing to railways, water traffic ceased to be important and coal became easily obtainable. The banks remained as the greatest danger, and, on occasions, even in the last decade every fenman near Ely has been called out to work both by night and day, while some houses were evacuated ; even troops and undergraduates from Cambridge were summoned to help in saving the banks, and hourly bulletins were issued. In these later days the control of the sea was better understood, but the problem here was vastly different from that of the Zuider Zee. The Fenland with its islands carried a considerable population, while the Wash, with its strong tides and open waters, makes the building of any large controlling dam, while quite unthinkable centuries ago, almost impossible even to-day.

Mr. Darby is to be congratulated on his remarkable study of the Fens. His every historical statement is supported by reference and selected with a real grasp of essentials. A chapter showing why the reclamation of the Fens became a national rather than a local matter would have helped in the study of his research. We should also like to know more of the Fenland peoples and their change from mainly pastoral to almost purely agricultural life. The principal crop in the eighteenth century was rape, its Fen name "cole". While at present it is only used for feeding purposes, particularly for sheep, its seed was then an extensive source of oil (rape, colza oil, etc.). The Fenland is no longer a grazier's country, but a land of corn, potatoes and beet. Occasionally mustard and buckwheat fields diversify the landscape, and in places horticulture, flower and fruit farmings have been extensively developed. As a whole, the Fens are prosperous, but many areas require scientific treatment, some perhaps a reclaying, others an attention to the water-level, and, surprisingly perhaps, others a retention of ground moisture that the addition of humus alone can give. Can we stimulate Mr. Darby to tell us, out of the abundance of his knowledge, a little of the more human side of the Fenlands, leaving aside for a time the technique of research ?

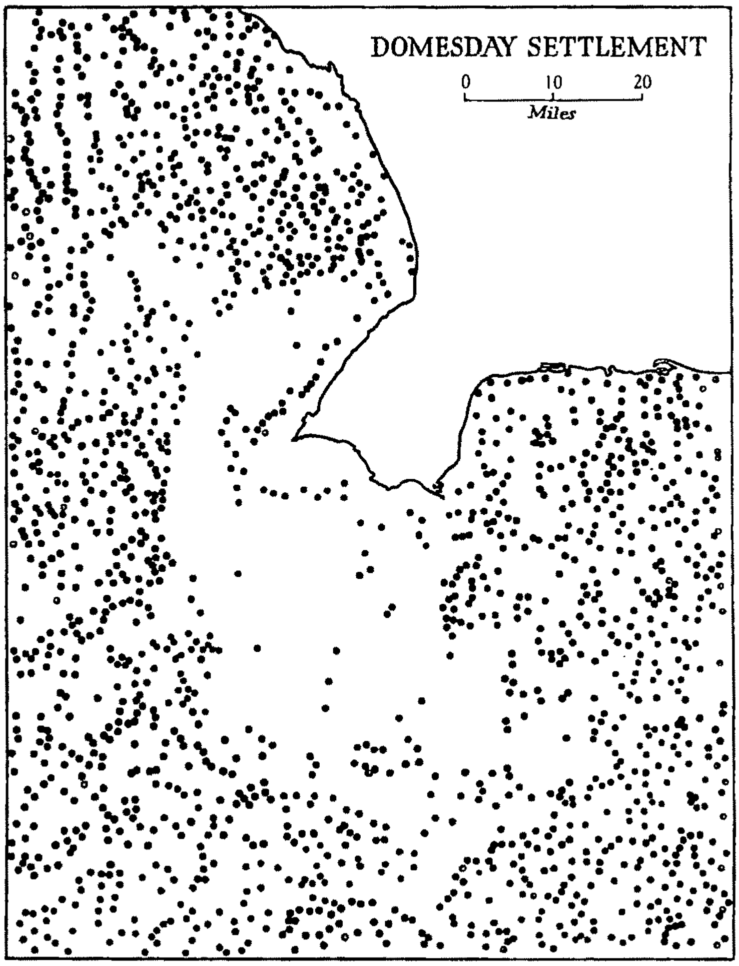

Fig. 2.
FROM "THE MEDIEVAL FENLAND".
THE SETTLEMENTS OF THE PEAT WERE UPON THE ISLANDS (SEE FIG. 1). THE BRECKLAND COUNTRY TO THE EAST WAS VERY SCANTILY SETTLED.

OBITUARIES

Prof. W. C. Brøgger, For.Mem.R.S.

Dr. W. C. Brøgger, professor emeritus of mineralogy and geology of the University of Oslo, died on February 17, at the age of eighty-eight. Born at Oslo (Kristiania) in 1851, Brøgger started his scientific career as a zoologist, but soon, through the inspiring influence of Th. Kjerulf, professor of mineralogy and geology, entered upon the study of the two subjects in which he was to accomplish so much. Before he was thirty years old, he received a call to Stockholm as professor, having already to his credit a large number of important papers on mineralogy, general geology and palæontology. A particularly valuable publication of his early years is his treatise on "Die silurischen Etagen 2 und 3 im Kristianiagebeit, etc." (1882), where besides describing the stratigraphy and fossils of the Upper Cambrian and Lower Ordovician, he gave a preliminary, yet very comprehensive, survey of the igneous rocks of the district, a field of research which was to become the central one of his life. A most important geological paper from the Stockholm period is "Ueber die Bildungsgeschichte des Kristianiafjords", where the block-fault structure, with breccia and other accompanying phenomena, was demonstrated with exceptional clearness.

After the death of Kjerulf in 1890, Brøgger returned to Oslo as professor, and in the same year published what is probably his most famous paper, on the minerals of the syenite-pegmatite dykes of the Oslo area, especially of the Langesundsfjord in the southern part. This monograph of about 700 pages, coupled with his previous works, brought Brøgger the Murchison Medal of the Geological Society of London and other high rewards. It deals not only with a wonderfully rich variety of minerals, but also with wide petrological and geological problems, and has made the district classical, attracting to it great numbers of mineralogists and geologists from many countries, who often enjoyed the personal guidance in the field of Brøgger himself.

In the course of his long life, Brøgger continued to publish papers, especially on the alkaline rocks of the Oslo area, which furnished him with magnificent examples of rock differentiation and with material for the original description of very numerous and characteristic rock-types (lardalite, larvikite, nordmarkite, etc.). He showed the close chemical and mineralogical relation of the vast variety of rocks involved, occurring as plutonic bodies, as sills and dykes, and as lavas, with, in the main, a change from more basic to more acid types. Together with his assistant, and later on successor, J. Schetelig, he published a series of valuable geological maps of the Oslo area. Other of Brøgger's petrological studies dealt with Archæan rock-suites from southern Norway, and with a most interesting series of igneous carbonate-bearing rocks in the Fen district, just outside the Oslo area. The paper on the Fen rocks, reaching several hundred pages in length, was published in his seventieth year.

It is a most imposing proof of the universality of Brøgger as a man of science that we also owe to him the largest and, we may add, the most important work, that has been published on the Quaternary geology of Norway, a book (published in 1900–1) dealing with the unconsolidated deposits occurring around the Oslo Fjord, with far-reaching conclusions on the geographical and climatic history of the district; and further, that he has given us the first full treatment (1905) of the relation of the Stone Age settlements to the varying height of the shore line in the same district—an achievement of fundamental importance to Norwegian archæologists.

Brøgger has not only in his personal research work been one of the most prominent men of science whom Norway has ever produced (his scientific honours could be counted in scores, including, among others, membership of the Royal Society and the Paris Academy of Sciences), but in addition, through his administrative abilities, he was able to promote Norwegian scientific life in general more than any other man. Of particular importance was his successful work in establishing a great number of funds for scientific research, some of them very large, together with his activities on behalf of the University at Oslo, which resulted in a number of new appointments, new buildings (including the natural history museums), etc. Brøgger was also, as a matter of course, for decades the central and leading personality in the Academy of Sciences at Oslo, the activities of which owed much to him in different ways.

Brøgger was a man with wide interests outside the realm of science. It is perhaps worth mentioning just now that so long ago as 1899 he was one of a committee of six outstanding representatives of European intellectual life who in St. Petersburg requested an audience with the Czar of Russia, in order to lay before him an address, signed by more than a thousand prominent men, in protest against new and oppressive regulations towards Finland. They were not granted an audience, but their effort gained for them the lifelong gratitude of the Finnish people.

Olaf Holtedahl.

Prof. E. Mapother

Prof. Edward Mapother, who died on March 20 at the age of fifty-eight, had been medical superintendent of the Maudsley Hospital since its opening. Under his wise and energetic control, it became the chief post-graduate centre of psychiatry in Great Britain. Mapother was selected to fill the newly created chair of clinical psychiatry in the University of London, tenable at the Maudsley, in 1936. This was a personal appointment, which he continued to hold after he had resigned from his post as superintendent of the Hospital last December; it was an acknowledgment of the remarkably effective and far-sighted way in which he had used his position, from the beginning, to further psychiatric teaching and research.

Very great importance was attached by Mapother to this side of his work, and he felt strongly that it demanded the full time of one man, though it had been impossible for him to give it full time because of his administrative duties as superintendent, which were heavy. He fretted constantly at the restrictions which his other work imposed upon what he felt he ought to be doing in this regard, and more than a year ago he drew up a plan for the reorganization of the staff of the Hospital, which provided for the permanent separation, in different hands, of his two main functions. Owing to his tireless energy he accomplished much more, however, than he believed; and the influence of his teaching and of his guidance of the general lines of research was far-reaching.

Mapother was himself first and foremost a clinician; and all his investigations were primarily clinical, for example, into alcoholic morbidity, the mental effects of head injury, and the neuroses of war. He understood very well, though, that research must be conducted along many lines, somatic, psychological and social, if knowledge in this conspicuously difficult and complex subject was to be advanced, and he sought constantly to synthesize neuro-physiology and psychology. He recognized two important needs: to bring into psychiatry first-class men, and to ensure that they should have a good training both in clinical psychiatry and in whatever scientific methods they were going to apply to psychiatric problems. He was aware that, in the past, fewer able men have been attracted towards psychiatry than towards other fields in medicine, and he thought that the best way to remedy this was to build up an outstanding university centre the achievements of which, especially in research, would influence the standards and reputation of psychiatry. Through the help of the Commonwealth Fund of America, and especially of the Rockefeller Foundation, he was able to carry this project a long way; the London County Council showed a generous understanding of the value and importance of Mapother's efforts, which could not have been realized without its concurrence.

Mapother was a remarkably good judge of men, as was inevitable in so penetrating a clinical psychiatrist; he saw through empty professions and slipshod efforts, but was critically appreciative of good work. He therefore succeeded in gathering around him a group of able men who were glad to work under the conditions available at the Maudsley. He was determined that there should not be dilettante research in his hospital. He had seen the harm done by this, both in the more academic forms of research and in investigations into clinical problems, and he was careful, in the selection and training of his staff, to ensure that they should be thoroughly competent in the research methods employed. To his insistence on this must be largely attributed the high level of the research done under his stimulus and direction. He was happy to know, in the last few months of his life, that the War had not led to the disintegration of his staff, but that they were working, in the two hospitals to which they had removed, on those problems of psychiatry arising in war, to which he had himself paid so much attention.

Mr. E. T. Cottingham

Science, and more particularly the precision time measuring side, loses in the death of Mr. E. T. Cottingham one of the few outstanding men of Great Britain engaged in this research.

He was born at Ringstead, near Thrapston, and, although originally apprenticed to a tailor, his love for mechanical timepieces overcame his father's desires, eventually giving to Mr. Allen the task of teaching him to be a clockmaker in the village of Thrapston, where the whole of his life was spent.

Throughout, his interest has not been centred on one problem, for so varied were they that a few, such as church clocks, sewage pumping machinery, and fitting the surrounding blast furnaces with pyrometers, etc., occupied his attention. The proximity to Cambridge naturally gave him other problems which he so loved to solve. The advent of radio enrolled him as an early student and pupil and, I believe, he was one of the first to install his experimental set, dated October 1912. Wireless and time signals being inseparable, and from this to astronomical time-keeping, the care of the instruments at Greenwich in due course followed. He was also invited and accepted the invitation to accompany Sir Arthur Eddington in 1919 to Principe on the eclipse expedition. He will always be remembered for his simplification of the principles of Dr. Reifler's escapement, and the models he has left in the various observatories of the world stamp him as a genius in design and craftsmanship where simplicity is the keynote.

Frank Mercer.

We regret to announce the following deaths:

M. Nicholas Arnold, honorary general administrator of the Belgian Colonies, who had a large share in the development of the Congo under Belgian auspices, especially from a horticultural and botanical aspect.

Sir George Buchanan, K.C.I.E., consulting engineer especially concerning harbour, docks and river works, on April 14, aged seventy-four years.

The Right Hon. H. A. L. Fisher, O.M., F.R.S., warden of New College, Oxford, on April 18, aged seventy-five years.

Dr. A. C. Haddon, F.R.S., emeritus reader in ethnology in the University of Cambridge, on April 20, aged eighty-four years.

Prof. Heinrich Preiswerk, visiting professor of mineralogy in the University of Basle, aged sixty-four years.

Prof. W. R. Scott, F.B.A., Adam Smith professor of political economy in the University of Glasgow, on April 3, aged seventy-one years.

NEWS AND VIEWS

Prof. A. Virtanen: Helsinki

ON February 28, while the Russo-Finnish War was still in progress, the Editors wrote to Prof. Artturi Virtanen, of the Biochemical Institute, Helsinki, inviting him to send a message to scientific workers at large. Readers, and especially those interested in biochemistry as applied to agriculture, will be pleased to learn that Prof. Virtanen is safe and hopes to continue his scientific work. A letter, dated April 1, has just reached NATURE office, in which Prof. Virtanen writes: "I thank you for your kind letter of February 28, and am pleased to say that I have managed to retain my life during the war. My scientific work was, however, interrupted from the beginning of November. The danger to which my country and our civilization was subjected necessitated my taking up other kind of work. Our institute was emptied owing to the men joining the army and the young ladies being engaged on women's auxiliary labour. Three of my collaborators gave their lives for their country: L. Mansikkala, M.A., L. Eerola, M.A., and A. Arhimo, M.A., all men on whose forehead our Lord had written the word Honour. Together with Mr. Arhimo I have in this journal published two Letters to the Editors concerning the oxaloacetic acid and other keto acids in the plants. Following the destructive air bombing of Helsinki on November 30, I wrote my last letter to NATURE, as there was a possibility of my not being able to continue my work. Should circumstances permit, I hope to resume my reports to NATURE in the near future."

Prof. Alexander Findlay

FIVE years ago, Prof. Alexander Findlay published a characteristically comprehensive and interesting monograph on "The Teaching of Chemistry in the Universities of Aberdeen". His own approaching retirement from the chair of chemistry at Aberdeen, a chair which he has occupied with distinction for twenty-one years, inspires the thought that when some future scientific historian undertakes the task of bringing this volume up to date, he will find Prof. Findlay a subject as fascinating and as significant as any of his predecessors. A graduate himself of the University of Aberdeen and a research student under Ostwald at Leipzig, Findlay became recognized, very early in his career, as one of the leading promoters of physical chemistry in Great Britain and, before returning to his *alma mater*, held the positions of lecturer in physical chemistry in the University of Birmingham and professor of chemistry at the University College of Wales, Aberystwyth.

Pressure of teaching duties and lack of adequate laboratory facilities have unfortunately restricted Findlay's natural bent for original research, but ample compensation for this restriction is provided by the steady flow of text-books and 'popular' volumes of science with which he has instructed thousands of chemists and entranced multitudes of laymen. Few physical chemists of the present generation have not been nursed upon Findlay's "Phase Rule" or "Practical Physical Chemistry" (to mention only two out of many); no chemist of the present generation has attracted a larger outside following than Findlay in "Chemistry in the Service of Man" or "The Spirit of Chemistry". It is to be hoped that the greater degree of freedom afforded by the new phase of professor emeritus will permit him to delight the component body of his friends and admirers with many more such works of art.

Dr. H. Melville

DR. H. MELVILLE, of the Laboratory of Colloid Science, Cambridge, who has been appointed to succeed Prof. Findlay, is well known for his work on the mechanism of gaseous reactions. His first important series of papers dealt with the oxidation of phosphorus at low pressures, in which it was shown that the diffusion of active molecules or radicals to the walls of the reaction vessel is a dominant process in regulating the velocity of oxidation. Theoretical advance was also made by the discovery of a method for measuring the branching of reaction chains in the oxidation of phosphine, one of the essential processes in controlling explosions in gases. This was the first estimate of this coefficient. He has also contributed to our knowledge on the photodecomposition of the hydrides, the low quantum yield being traced and proved to be due to the occurrence of the recombination of the primary products of decomposition; this investigation led naturally to a supplementary one on the kinetics of exchange reactions of deuterium with the simple hydrides.

Latterly most of Dr. Melville's work has been directed to the elucidation of the mechanism of polymerization reactions. Suitable polymerizations have been found which occur in the gas phase photochemically and are amenable to kinetic study. One of the interesting results has been the discovery of molecules which grow, after photo-activation, in the dark for very long periods. Molecules of any size can thus be produced. By studying interpolymerizations it has become possible to build molecular sandwiches. Methods have also been developed for determining kinetically the molecular weight of polymers and for examining in detail the molecular statistics of the individual steps in a polymerization reaction, thereby leading to the exact control of molecular growth.

Karl Toldt (1840-1920)

PROF. KARL TOLDT, an eminent German anatomist and anthropologist, was born at Bruneck in the Tyrol on May 3, 1840. He received his medical

(*Continued on page* 663)

NATURE

SUPPLEMENT

Vol. 145 SATURDAY, APRIL 27, 1940 No. 3678

SHORT REVIEWS

ANTHROPOLOGY

Akiga's Story

The Tiv Tribe as seen by one of its Members. Translated and annotated by Dr. Rupert East. (Published for the International Institute of African Languages and Cultures.) Pp. xv+436+24 plates. (London: Oxford University Press, 1939.) 21*s.* net.

IF support were needed for the policy of the International Institute of African Languages and Cultures in encouraging the African to express himself in literary form, it might well be drawn from this volume. The author has been engaged for more than twenty years in collecting information relating to the traditional customs of his people, the Tiv, who, to the number of more than half a million, live on the banks of the Benué in northern Nigeria. Although it is true that his action long preceded any possibility of encouragement by the Institute, which came in only at the latest stage, the result of his labour, or at least that part of it which has now been published in translation, is remarkable for its power of logical thought, its arrangement, and its grasp of the essential. If the efforts of the Institute succeed in discovering writers of anything like the same calibre among the peoples of Africa, even if their numbers are relatively small, the policy is wise, and energies have not been expended in vain.

Akiga was the first of his people to attend a school, and although a Christian, and an active preacher of Christianity among his people, he records the traditional customs and beliefs of his people in pagan days with an objectivity and detachment which should find favour in the eyes of the anthropologist. Where his narrative falls short of the requirements of an ethnographical treatise, as it does at times, his translator, Dr. East, has done much to make good the deficiency by his supplementary and explanatory notes, in which he endeavours to supply the background necessary for understanding in a reader who knows neither the country nor the people. Author and commentator, between them, supply an instructive picture of a state of society which now to a great extent has passed away, largely owing to the efforts of the administration to restrict the leaning of the Tiv towards a preference for variety in their forms of marriage, by admitting one form only as legal. From Akiga's story it will be learnt why the election of one particular form, though well-intentioned, was mistaken, and why the native holds the white man as responsible for the ruin of the country.

Europe and West Africa

Some Problems and Adjustments. By Dr. C. K. Meek, W. M. Macmillan and E. R. J. Hussey. (University of London: Heath Clark Lectures, 1939, delivered at the London School of Hygiene and Tropical Medicine.) Pp. v+144. (London, New York and Toronto: Oxford University Press, 1940.) 10*s.* net.

IN this, the eighth of the series of Heath Clark Lectures of the University of London, "the educational, cultural and humanistic aspects of the History, Development and Progress of Preventive Medicine and Tropical Hygiene" have been construed in the broadest sense. They deal with the cultural changes and adjustments which are and have been taking place in West Africa as a result of the impact of European civilization. Dr. Meek opens the course with two lectures in which he draws upon his experience as an administrator, mainly acquired, as he points out, in Nigeria, to give in broad outline a summary of West African racial and cultural conditions and to indicate some of the principal social and economic factors affected by or affecting the course of contact development.

Prof. Macmillan, from his wide experience of African social and economic problems, provides an acute and penetrating analysis of a situation arising out of the development of the mining and cocoa industries and the difficulties which confront administration in the mixed communities resulting. Finally, Mr. Hussey considers the contribution of education to the solution of the problem of African development, construing his terms of reference in so wide a sense as to examine the position of 'indirect rule' as a factor in education. Those who are interested in the future of African peoples will find much stimulating food for thought in the indications afforded by both Prof. Macmillan and Mr. Hussey that indirect rule is not a magical formula which can be applied to all conditions and circumstances—as, for example, on the Gold Coast—without discrimination.

ASTRONOMY

A Star Atlas and Reference Handbook (Epoch 1920-1950)

For Students and Amateurs. By Arthur P. Norton. The Reference Handbook by J. Gall Inglis and A. P. Norton. Seventh edition. Pp. xii+52+18 maps+xiv–xxii. (London and Edinburgh: Gall and Inglis, 1940.) 12*s*. 6*d*. net.

IN the fifth edition of this work the constellation boundaries were drawn in accordance with the scheme adopted by the International Astronomical Union in 1930, and this plan has been followed in the sixth and present editions. Among the additions to the seventh edition may be noted a revised and enlarged index to contents and also on the last page an index to constellations and charts. Precession tables on p. xvii with an example of their use is another addition which will prove useful. The chief enlargement in the work has been made in a greatly extended list of "Interesting Objects", the number having been increased from 130 in previous editions to 523. The positions of these objects are referred to the equinox of 1950.0, which will be a standard of reference for a considerable time. The first four sections of the "Reference Handbook" at the beginning of the work supply useful information on a large number of astronomical terms, while the fifth and sixth sections give hints to observers and instructions on the use of the telescope. The work is intended primarily for the use of the amateur observer whose telescope is mounted either on an alt-azimuth stand or as an equatorial without graduated circles. It will certainly fulfil its object, and every amateur who is anxious to do useful work should be in possession of this volume. M. D.

An Easy Guide to the Constellations

(Based on the work of the same name by Rev. James Gall). With a Miniature Atlas of the Stars. By J. Gall Inglis. Pp. iv+86. (London and Edinburgh: Gall and Inglis, 1939.) 1*s*. 6*d*. net.

THE original of this book was published more than eighty years ago and was based on illustrated talks given to working lads in Edinburgh. The present author—a grandson of the original author—enlarged and partly rewrote the book many years ago, and now he has extended its scope to include some of the recent developments in astronomy.

A brief outline is given of many useful facts in astronomy in simple language that will prove very helpful to boy scouts especially, but others interested in the elements of astronomy will also find much useful information. The star maps are clearly drawn and with each of these there is a brief description of the times in various months when they south; this will help the amateur to identify them if in doubt. A very important feature is a list of constellations, stars and planets with the pronunciation of their names. The little work will serve a useful purpose. M. D.

BIOLOGY

Practical Animal Biology

By T. L. Green. Pp. x+276. (London: Allman and Son, Ltd., n.d.) 4*s*. 6*d*.

A PRACTICAL book in animal biology for use in schools, of a simpler nature than that used by first-year university students, is assured of a welcome. Mr. Green has combined a study of living animal types with investigation of their morphology. Shorter sections deal with chordate embryology, histology and physiology. There are nearly one hundred text figures. The text is fully descriptive and should be adequate for the scholar. Questions to be investigated by him are suggested throughout. The experiments in the physiology section have been well chosen and will certainly interest him.

The book, however, seems to have been hastily put together; there are inaccuracies in the text, and in some places where the text is sound the accompanying figure is at variance with it. For example, Fig. 55 tells the student that the abducent nerve supplies the *superior* rectus muscle, whereas the text and Fig. 56 indicate that this nerve goes to the *external* rectus muscle. As this nerve is usually very difficult to trace, what is the pupil to believe? Or again, the description of the innominate artery (p. 171) is correct; but any observant pupil will soon find out that the figure of it (74) is wrong. In the text the sequence of the factors of the right anterior vena cava in the rabbit (p. 170) should be *b*, *c*, *d*, *a*, *e*, *f*, and not as arranged by the author. In the embryology section, the germinal layers are named ectoderm, mesoderm and endoderm, but thereafter, without explanation, though with occasional lapses, they are called epiblast, mesoblast and hypoblast. Such inaccuracies detract from the value of an otherwise useful book, and illustrate how difficult it is to write a good text-book.

Laboratory Outline for General Zoology

By Prof. George Edwin Potter. Pp. 276. (London: Henry Kimpton, 1939.) 8*s*. 6*d*. net.

THIS sheaf of loose leaves, perforated for filing, comprises notes and hints on dissection, interleaved with sheets for drawings. The type method is employed, the range being somewhat similar to that of a first-year course in zoology in Great Britain, with the notable absence of a mammal. There are questions on each type, and suggestions for demonstrating various points. Outline drawings and schematic sections have been printed, and the student is expected to fill in the detail. How far this will encourage the student to scamp genuine observation is a debatable point, and most zoologists in Great Britain would consider it inadvisable to do too much for the student, however much time and labour for the teacher are saved thereby. The frog's skull, for example, has been drawn with every bone outlined, and all the student need do is insert the names and send in his sheet to be marked. The author aims at making the student "rely on his own judgment". Surely it is equally important to stimulate and train his powers of observation.

In the first insect type the name of the insect has been omitted, and the reviewer's copy has a duplicate page in this section. The descriptions are clearly expressed, and since scientific terms and new words are printed in italics, the student can look these up in the "Text-book of Zoology" previously published by the author.

Nature Parade

By Frank W. Lane. Pp. 316+53 plates. (London: Jarrolds, Ltd., 1939.) 15*s.* net.

BY far the majority of books which set out to describe events and happenings in nature are limited in that they are personal records of one or two observers only. The value of this book lies in the fact that the author has made a synthesis of innumerable records from various observers. The more general sections deal with subjects like animal food, toilet, sleep, leadership, strength, war and doctoring, while a considerable portion of the book is given over to a useful and original résumé of speed and locomotion in the animal kingdom. In a shorter section, which falls below the standard of the rest of the book, there is a rather verbose description of rare and mystical animals. "Nature Parade" rightly justifies its author's claim to be "a nature book with a difference" and contains much interesting information. It suffers by its too 'popular' and anthropomorphic approach and the absence of references to original documents. Some remarkable photographs by leading nature-photographers do much to enhance the usefulness of the book. T. H. H.

A Contribution to the Biology of North American Vespine Wasps

By Prof. Carl D. Duncan. (Stanford University Publications, University Series: Biological Sciences, Vol. 8, No. 1.) Pp. 272+54 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 15*s.* net.

THIS memoir deals with North American paper-making wasps of the subfamily Vespinæ. It is divided into four sections: an introduction, a morphological section, a systematic section and a biological section. The morphology is concerned with the skeletal and muscular systems of *Vespula pennsylvanica*. The systematic part is concerned with genera and not species, while as regards biology numerous observations are given on habits, behaviour, nest-building and life-history. An extensive bibliography is appended, but the literature is not exhaustively reviewed, since the work is in no sense claimed to be a monograph.

CHEMISTRY

Laboratory Exercises in Inorganic Chemistry

By Prof. James F. Norris and Prof. Kenneth L. Mark. (International Chemical Series.) Second edition. Pp. xiii+574. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 12*s.*

WITH the publication of a new edition of "Inorganic Chemistry for Colleges", Profs. Norris and Mark have now revised "Laboratory Exercises in Inorganic Chemistry" to make it complementary to the theoretical treatise. Additional experiments have been introduced to illustrate the chemistry of colloids, *p*H, and buffer solutions; otherwise the general plan of the book remains as before.

It is often said that experience is the best teacher, and the authors have fully supported this view in presenting a book which gives thorough training to students in all branches of practical inorganic chemistry. Very wisely, special emphasis is laid on the acquisition of fundamental bench technique as an early step in the student's training. This is followed by a systematic course covering the preparation and well-known reactions of many simple inorganic chemicals.

Each exercise consists of three parts: discussion, practical directions and questions. The last part is formulated in such a manner as to show that both the chemistry and the technique of the exercises have been mastered. An unusual feature of the book is the provision of blank pages for the students' notes. This system, which renders the book ultimately a combined text-book and note-book, should be of great value to the instructor.

The book can be heartily recommended to students entering on a chemical course. A careful study of the theory contained in the text and a mastery of the laboratory technique presented will prove a sound basis should the student desire to embark on more advanced chemical courses.

The Chemistry of Milk

By Dr. W. L. Davies. (Monographs on Applied Chemistry, Vol. 10.) Second edition. Pp. xiv+534. (London: Chapman and Hall, Ltd., 1939.) 25*s.* net.

IN reviewing the first edition of this book in NATURE, 138, 625 (1936), attention was directed to the rather large number of errors and inaccuracies in what should have been an indispensable and infallible weapon in the hands of the dairy technologist. So far as can be discovered, a few of these errors have been corrected in the new edition, but many remain. In addition to those cited in the NATURE review—and in others—may be mentioned a misquotation of Baumann and Steenbock (p. 490, last line but four), who found a 200 per cent variation in the vitamin A content of butter—not a 100 per cent variation, as stated by Dr. Davies.

The book remains the only work of its kind published in Great Britain. Every dairy chemist in the Empire probably possesses or has access to a copy. It is a national and imperial duty to secure that the facts supplied in this book are correctly given and clearly stated. The duty devolves upon publisher and editor, but still more on the author. It is therefore up to Dr. Davies, now himself the head of an important dairy research institute—a post that his own work in the field of analytical dairy chemistry fully justifies—to see that the third edition, which will surely be required in due course, is free from the many blemishes that disfigured the first and the second. A. L. B.

ENGINEERING

Electrical Engineering Experiments

Theory and Practice. By Prof. Henry R. Reed and Prof. George F. Corcoran. Pp. xii+500. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 22*s.* 6*d.* net.

THIS text-book will be very useful in electrical engineering laboratories. It covers a wide field, but most of the experiments have an individuality of their own and this gives a wide scope to the teacher, who will find much of the apparatus described and the instructions given in the book useful for physics and chemistry students. The large number of experiments described and the comparatively cheap nature of the apparatus required will be welcomed in colleges and technical schools which have only a limited equipment.

The text is divided into an introduction and seven sections. In the introduction the fundamental principles are first described, then direct current machines, alternating current circuits, transformers, synchronous machines, induction machines and electronics. Ample theory is given with each experiment, so that the reader can do most of them without detailed reference to other books. Exercises within the scope of a given experiment are so arranged that a portion or the whole can be performed, as time permits, without breaking up too much the continuity of the experiment. It will be particularly valuable to students taking a second year course in electrical, mechanical, chemical or telecommunication engineering.

The instructions given on how to write a report of the experiment done and the suggestions for further research work will save the teacher much trouble when the students ask him for hints as to suitable course work' to be marked for examination purposes. We can recommend the book to young graduates and others seeking for theses for higher degrees and to engineers who are beginning to forget the technique of laboratory research, and whose work makes it advisable that they should know it.

Instructions in Engineering Design

Vol. 2: Lattice Girder Bridge. By H. P. Philpot. Pp. viii+223+4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 10*s.* 6*d.*

IN the final stages of his study of engineering design, the student has the rather difficult task of working out a complete scheme for the construction of a machine or structure in accordance with a given specification. It is as if a soldier who had mastered the art of local tactics were required to prepare a strategic plan and the complete tactical operations involved in it. It is at this point that the text-books are found lacking, for they seldom show any one design worked out to its last and minutest details. These notes on the design of a lattice girder bridge have been prepared for the guidance of engineering students in response to many requests for a book to give them a lead in the methodical preparation of designs. The particular bridge dealt with has a span of 156 ft. between bearings and the girders are of the Pratt type. It carries a single line of rails and is of the 'through' type. The assumption is that it is being designed for the Indian railways and it is therefore necessary to follow the British Standard Specification for Girder Bridges, the Bridge Rules of the Government of India Railway Department and its Schedule of Dimensions, while the impact allowance conforms to the Indian loading.

Step by step the author works out the details and shows the application of the specifications quoted above, and it should be both instructive and satisfying for the student to see all the considerations involved being incorporated into a practical and efficient design. Beyond the mere calculations and results, the author's notes are of an explanatory nature, so that the progress of the design is made clear and the student is not placed in the difficulty of following quite obvious calculations without being able to see why this and not that method is employed. Not only is this a useful advanced class-book, it is also very suitable for the student or young draughtsman who has mastered the earlier stages of structural design.

MATHEMATICS

Applied Mathematics in Chemical Engineering

By Prof. Thomas K. Sherwood and Prof. Charles E. Reed. (Chemical Engineering Series.) Pp. xi+404. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 24*s.*

FORMERLY, chemical science merely required, in general, a little elementary arithmetic and algebra, but to-day a vastly greater mathematical equipment is essential. The book under review, written by chemical engineers, gives a thorough survey of the actual type of mathematics now required.

The first of the nine chapters gives an introductory review of the mathematical processes to be developed. It shows that many of the generalizations constituting the basic laws of chemistry are, like those of physics, expressible in differential equations which depend upon much empirical information. Chapters ii and iii are devoted to the problems of constructing ordinary equations and of solving them. Chapter iv deals with partial differentiation with special reference to thermodynamics. Infinite series and their use in the solution of ordinary and partial equations form the subject-matter of the next two chapters. The authors' aim in treating Fourier's series and the Bessel functions as simply and practically as possible has been well fulfilled. Chapter vii is concerned with the methods of fitting data to empirical equations, numerical integration and differentiation and interpolation. Illustrations are given in Chapter viii of the many graphical methods in use in chemical engineering design, together with a short section on alignment charts. The final chapter wisely discusses the theory of errors and the precision of measurements. A few practical exercises are placed in an appendix at the end and a good index is provided.

The subject-matter is very clearly treated and, as stated in the preface, "it should be possible for anyone with a good grounding in the calculus to follow the text without difficulty". The authors also commendably point out that there is no quick and easy method of gaining proficiency in any branch of mathematics without sustained, serious and concentrated study. This is a very necessary warning to all practical students, and especially to those for whom this valuable book has been prepared.

Mathematics for Actuarial Students

By Harry Freeman. (Published for the Institute of Actuaries.) Part 1: Elementary Differential and Integral Calculus. Pp. viii+184. 9*s.* net. Part 2: Finite Differences, Probability and Elementary Statistics. Pp. xiii+340. 25*s.* net. (Cambridge: At the University Press, 1939.)

THESE two volumes are designed to replace the author's "Elementary Treatise on Actuarial Mathematics", published in 1931. The replacement is rendered necessary by changes in the mathematical requirements of the examinations controlled by the Institute of Actuaries. Part 1 contains the chapters on trigonometry and elementary calculus taken, with little change, from the earlier book. Part 2 is almost a new work, for the remaining text of the former treatise has not only been re-written and expanded to bring it up to date, but also new chapters on elementary statistics have been added. The first nine chapters, occupying 203 of the 330 pages of text, are devoted to finite differences, and the treatment of this somewhat difficult subject is both interesting and sound. The four remaining chapters are concerned with an elementary discussion of simple probability and statistics. Here, again, the author has developed the subjects with clarity and skill.

In both books, the text is well illustrated by worked-out examples, and each chapter concludes with a good set of exercises for the practice of the student. In addition, each part contains a number of miscellaneous problems placed at the end. Answers to all the examples are also given.

The books are excellently printed and should not only be useful to candidates for the Institute's examinations, but also of practical value to all students of the important branches of mathematics dealt with.

Higher Mathematics

With Applications to Science and Engineering. By Prof. Richard Stevens Burington and Charles Chapman Torrance. Pp. xiii+844. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 30*s.*

WHILE special stress is laid, in the book under notice, on the practical application of mathematics to physics and engineering, yet the book compares favourably with a work on abstract rigorous analysis, although, as would be expected, the rigour is not carried so far as in a purely academic treatise. Of the nine chapters, the first four are concerned with the calculus of a real variable. These include the theorems of Rolle, Taylor, Green and Stokes; the Riemann theory of integration; ordinary and linear simultaneous differential equations with applications to electrical networks; numerical integration; brief discussions of Legendre and Bessel functions and series including the theorems of Féjer and Fourier. Chapter v is devoted to complex variables and elliptic functions, with applications to the pendulum and the rectification of an elliptic arc. Then follows in Chapter vi a consideration of determinants and matrices together with the elements of vector analysis, differential geometry and tensor analysis. Partial differential equations are dealt with in Chapter vii, whilst the last two chapters are devoted to the calculus of variations, analytical dynamics and an introduction to the theory of the real variable. The book concludes with a useful bibliography and a full index.

The text is, on the whole, clearly written, though obvious considerations of space have prevented a few topics from being as fully treated as might be wished. It is also well illustrated, both by carefully drawn figures and by fully worked-out practical problems, while numerous and judiciously chosen examples are provided for the student's practice. The authors have not only fulfilled their aim admirably but also have produced an interesting book, characterized by some excellent features, which should prove very useful to all students of applied science as well as to those of pure mathematics.

MEDICAL SCIENCES

Fundamental Principles of Bacteriology

With Laboratory Exercises. By Prof. A. J. Salle. Pp. xiii+679. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 24*s.*

THIS book, as the author is careful to point out, is intended to serve as a ground-work for those who are beginning the study of bacteriology as a biological science; it is in no sense an advanced text-book on the subject. In nearly seven hundred pages of excellent print the elementary principles are covered, ranging from the physiology and morphology of micro-organisms to the bacteriology of water, soil, air, food, etc., with short chapters also on infection and immunity and the diseases of plants and animals. An attempt has also been made to make the work a combined text-book and laboratory manual. This has been done by including short experimental sections at certain points in each chapter. A useful bibliography of the more important text-books and original papers is included at suitable places throughout the text. The task of compiling a book of this nature is a formidable one for a single author, and no doubt, for this reason, some obvious defects have arisen. In certain sections the facts presented are either completely out of date or they are not, as yet, accepted by the majority of workers. On the whole, however, the material is well presented and should be readily assimilated by the student.

Dr. Salle's book may not readily find a place in the teaching departments of many of the universities in Great Britain, where bacteriology remains an *ad hoc* subject tacked on as required to larger branches of applied science. We have not, as yet, decided that as a separate branch of biological science it is a subject worthy of a secure position in the university curriculum. Nevertheless, the inclusion of this book in our libraries is to be recommended, if only to illustrate and direct attention to the advanced stage of the teaching of bacteriology, as a separate science, on the American Continent.

Tuberculosis and National Health

By Dr. H. Hyslop Thomson. Pp. xi + 260. (London: Methuen and Co., Ltd., 1939.) 10*s*. 6*d*. net.

THIS is a valuable contribution to the epidemiology of tuberculosis, by one who has had exceptional opportunities of becoming familiar with the disease in his capacity of medical officer of health and county tuberculosis officer for Hertfordshire, and of former tuberculosis officer or medical superintendent of sanatoria elsewhere. The subjects discussed include the incidence of tuberculosis in man and animals, the types of the disease, etiology and infection, housing and tuberculosis, relation of tuberculosis to milk supply, importance of early detection and treatment, modern treatment and after-care, and tuberculosis and the nursing service.

A bibliography of almost exclusively British and American writers, arranged according to each chapter, is appended.

Prevention of Venereal Disease

By Dr. Marie Carmichael Stopes. Third edition. Pp. xii + 62. (London: Putnam and Co., Ltd., 1939.) 2*s*. 6*d*. net.

THIS book is a revised and enlarged edition of a work published under another, though similar, title in 1921, and since reprinted on several occasions. It deals with the causes and prevention of venereal diseases and discusses the relation of promiscuous sex intercourse to their spread. The author, though not medically qualified, has written many popular works on sex subjects, and gives, in this volume, several quotations of the views of medical men on the questions at issue. She describes the technique of disinfection to be applied when risks have been taken, a procedure in which she is a strong believer.

Some of the medical references are not quite up to date, and the new treatment for gonorrhœa, which is one of the most important medical happenings in recent years, is not mentioned.

The psychological effect of statements about the uncertainty of cure has presumably been considered by the author; but those who have had experience of the phobias which the victims of these diseases are apt to develop would have preferred that vague assertions of this kind should not have been made.

Nevertheless, this book does a useful service in directing attention to diseases the causes and effects of which should be known to all young people, and concerning which there is still a denial of publicity through ordinary channels.

METALLURGY

The Physical Examination of Metals

By Bruce Chalmers. Vol. 1: Optical Methods. Pp. viii + 181 + 4 plates. (London: Edward Arnold and Co., 1939.) 14*s*. net.

METHODS which have not yet become part of the metallurgist's technique are the subject of this book. After a short introductory chapter on the properties of light, the applications of geometrical optics are discussed with special reference to the examination of metal surfaces, the measurement of reflectivity and the optical properties of thin films. Two chapters are then devoted to wave optics, under the headings of interference and diffraction phenomena. The principles of parallel and inclined plate interferometers are explained, and some applications, reaching a pinnacle of elegance in the author's precision extensometer, are described. Methods of examining films and coatings on metals involving interference colours and fringes are also described. Applications of diffraction phenomena include the measurement of fine meshes and particle size of powders, and an explanation of microscope resolving power.

Chapter v is devoted to the theory of polarized light, the experiments of Tronstad and of Lavery, and microscopical technique for identifying inclusions and determining state of strain. The final chapter deals with two optical methods in which the source of the light is the point of interest, namely, radiation pyrometry and spectrography. There is more 'meat' in this book than is revealed by a casual survey; the author has evidently taken great care in his selection of material, and, with his gift of clear expression, has enabled the average metallurgist to absorb quite a lot of physics without too much labour. Incidentally, one is still permitted to believe in an 'aether' for the purpose of the book.

Principles of Metallography

By Prof. Robert S. Williams and Prof. Victor O. Homerberg. (International Chemical Series.) Fourth edition. Pp. ix + 339. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 23*s*.

THE popularity of this book is explained by the way in which the authors have succeeded in combining clarity with brevity. The treatment of fundamentals is, however, a little superficial in some respects. In the new chapter on plastic deformation, for example, no hint is given that metallic crystals are anything but perfect in structure, and one would prefer to see the early chapters, on the equilibrium diagram, extended at the expense of the final chapter on laboratory methods. The list of alloys given in the appendix might be replaced with advantage by a select bibliography. Printing, illustrations and binding are excellent.

MISCELLANY

Science and Civilization

By Dr. Bernard Lovell. (Discussion Books, No. 63.) Pp. 150. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1939.) 2*s*. net.

DR. LOVELL can be heartily congratulated on the admirable way he has discharged a difficult task. Within a hundred and fifty pages, he has given us a lucid and balanced outline of the training of the man of science, the organization of research, and its interactions with society, the factors which impede scientific advance and social progress, and a glimpse of the possibilities science holds for civilization could these obstacles be overcome; it should prove as stimulating to the general reader as to the scientific worker himself. This little book can be commended as a direct basis for discussion on the relations of science and society or as an introduction to the brief but growing scientific literature written with social consciousness. Its interpretation of scientific men and their work in the light of social responsibility, no less than its indication of the ways in which the frustration of scientific knowledge persists and indeed extends, and of the threats to intellectual liberty and life throughout the world, are well calculated to stimulate increasing numbers of scientific workers to consider the social aspects and responsibilities of their work, and attempt the interpretation of science in its social context.

The great value of the book is in its contribution to education for citizenship, whether of the scientific worker or of the general reader. It is therefore unfortunate that in his preface Dr. Lovell suggests that the universities should be re-directed to produce men educated as citizens *instead of* exact scholars. Great as may be the need for the universities to serve the community by providing graduates who are trained as citizens, competent to think accurately about the great problems of to-day and alive to the human issues underlying the decisions they are called upon to take, it must not, as Dr. Lovell's words seem to imply, be at the expense of either scholarship or the critical intelligence they are equally called upon to exercise. Changes in teaching or curriculum at the universities which will assist the development of personality and social consciousness are indeed desirable. They must not, however, be allowed to impair the integrity or exactitude of scholarship or scientific competence.

Civil Defence

A Practical Manual presenting with Working Drawings the Methods required for Adequate Protection against Aerial Attack. By Capt. C. W. Glover. Second edition, completely revised and enlarged. Pp. xviii+764+74 plates. (London: Chapman and Hall, Ltd., 1940.) 36*s*. net.

THE defence of the civil population against air attack has become a science of considerable magnitude, in which the problems cover a wide range from structural engineering, chemistry and fire fighting to the control and psychology of crowds. This second and enlarged edition of Capt. Glover's book is a very useful and comprehensive manual of protection against aeroplane bombs, in which technical details, graphs, mathematical data and costs are given. It also deals with matters of general interest. The diagrams of bombs, twice the size of a man, and the fact that in some of the raids in the War of 1914–18 one third of the casualties were caused by fragments from our own anti-aircraft fire, will come as a revelation to many people.

A large part of the book is devoted to shelter protection in buildings, trenches and dug-outs, and comparative costs are given. Alternative solutions to the pressing problem of the replacement of crumbling sandbag parapets by such methods as sand-filled hollow concrete blocks are not, however, mentioned, and the difficulty of the all-important question of the draining of trenches and dug-outs receives little attention.

There is a fascinating chapter on camouflage, one on anti-gas measures, with appendixes giving the properties and effect of the various war gases, and another on factory protection.

In the chapter on the organization of A.R.P., diagrams show the organizations in France, Germany and England. The complexity and lack of co-ordination in the English organization compared with the Continental nations is very marked, and lends credence to the story that at a certain first aid post and party depot, one half was sandbagged and the other not, since the Home Office, which deals with first aid parties, said 'sandbags' and the Ministry of Health, which deals with first aid posts, said 'no sandbags'. E. H. K.

Problèmes de la vision

Par Armand de Gramont. (Bibliothèque de Philosophie scientifique.) Pp. 282. (Paris: Ernest Flammarion, 1939.) 22 francs.

THE title of this book is somewhat misleading, since in its short compass it covers the essential facts of how we see, and adds many suggestions which are not to be found elsewhere. It consists of three parts: (1) the eye and its defects; (2) the spatial medium—points, lines, directions, optical delusions, surfaces, volumes, stereoscopic relief, and architecture; (3) chromatic transmission—heterochromatic photometry, colour sensations and contrast, colour blindness, and the perception and transmission of colours.

The author writes with the remarkable clarity and scientific accuracy which we associate with the best French men of science; but he is no slave to orthodoxy. Whilst the facts are accurate, the interpretation of function shows a bias towards the less generally accepted theories. Thus, owing to the acknowledged difficulties of the morphological discrimination of rods and cones, he is inclined to undervalue the physiological arguments in favour of the duplicity theory, which, indeed, receive less attention than they deserve. He rejects Helmholtz's theory of accommodation in favour of that of Tscherning, and also both the Young-Helmholtz and the Hering theories for one of piezo-electric resonance of his own.

These peculiarities do not detract from the value of the book, especially for those already *au fait* with the subject; and its value is further enhanced by interesting applications of the facts to art and architecture. Thus he points out that oddities of drawing, such as those of El Greco—and it has also been said of Sargent—cannot be attributed, as has been done, to astigmatism of the painter's eyes. On the other hand he goes so far as to state that Vermeer's "View of Delft" shows characteristics which prove that the artist was myopic. These and other suggestions of a similar nature add greatly to the fascination of the book, reminding one of Shelford Bidwell's "Curiosities of Light and Sight".

PHYSIOLOGY

Sex and Internal Secretions

A Survey of Recent Research. Editor: Edgar Allen. Pp. xxxvi+1346. (London: Baillière, Tindall and Cox, 1939.) 54*s*.

THIS well-known book is sponsored by the Committee for Research in Problems of Sex of the National Research Council of America. The first edition, published in 1932 to celebrate the completion of ten years work by the committee, soon established itself as a standard work of reference; the second edition is much larger than the first. It contains twenty-four chapters by different authors, most of whose names are known as the leading authorities in the fields with which they deal, and most of whom contributed to the first edition, though several new names have been added including that of an Englishman—W. H. Newton.

The field covered by this book is so wide that few people could properly appreciate all the different sections, which cover the genetic basis and embryonic development of sex, abnormalities of sex, the biology and chemistry of the testes and ovaries, the behaviour of spermatozoa, gonadotropic substances, the lactogenic hormone, the relation of vitamins to sex, and sex drive. There is a chapter on sex functions in man written from the clinical point of view, which deals not only with disorders of the sex organs, but also with the relation of sex to disorders in other parts of the body such as anæmia, hæmophilia and skin disease. There is a section on the biological assay of androgens and œstrogens which directs attention to the many sources of error in such assays, but which fails to emphasize the large chance errors associated with assays on small groups of animals, or to indicate the methods by which they can be reduced. The book will be invaluable to all serious students of the physiology of sex, but will not interest the dilettante.

Hearing and Equilibrium

By H. Macnaughton-Jones. Pp. viii+128+15 plates. (London: Baillière, Tindall and Cox, 1939.) 7*s*. 6*d*.

THE author has some original ideas on the working of the middle and inner ears, which he has illustrated by means of mechanical models. The book contains no account of recent work on the ear by other investigators, which is regrettable. It is difficult for the reader to solve for himself the problems which arise from an attempt to correlate the hypotheses put forward with the electrical effects which have been observed to occur when the ear is stimulated by sound.

PSYCHOLOGY AND PHILOSOPHY

The Nature of Creative Activity

Experimental and Comparative Studies of Visual and Non-Visual Sources of Drawing, Painting and Sculpture by means of the Artistic Products of Weak-Sighted and Blind Subjects and of the Art of Different Epochs and Cultures. By Viktor Löwenfeld. Translated from the German by O. A. Oeser. Pp. xvii+272. (London: Kegan Paul and Co., Ltd., 1939.) 21*s*. net.

THIS most interesting book is a study in the investigation of the creative activity of poor-sighted and blind subjects combined with a comparative study of the art of different cultures. The first section of the book is devoted to the study of children's drawings, the second to those of the weak-sighted, the third to a generalized study. There are more than a hundred pages of illustrations of children's drawings, together with a selection of drawings from weak-sighted individuals and various representations of historical types of art. The artistic creations of the blind and weak-sighted are largely based on the sense of touch and other senses.

Psycho-Analysis

By Dr. Edward Glover. Pp. viii+139. (London: John Bale Medical Publications, Ltd., 1939.) 12*s*. 6*d*. net.

THIS small book, which is dedicated to the memory of Sigmund Freud, attempts to give in one hundred and thirty-three pages the theory and practice of psycho-analysis. It can be said at once that the author has succeeded very well. The book is divided into two parts, the first dealing with theory, the second with the application of the theory to clinical practice. The author's statement that the psycho-analyst's interest lies in the early recognition and prevention of psychotic breakdown may be very praiseworthy, but we wonder how many cases of psychoses have been prevented by psycho-analysis and how many precipitated thereby. It is a good little book and worth reading.

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education in Vienna where he attended the Josephinum under Hering and Lange. He qualified in 1864, and twelve years later was appointed professor of anatomy at Prague where he superintended the construction of an anatomical institute, and after his transfer to a corresponding chair in Vienna collaborated with C. Lange in creating a similar institute there. In 1877 he published a text-book on histology, of which the third edition appeared in 1888, and in 1896–1900, in conjunction with Alois Dalla Rosa, brought out an anatomical atlas which went through fifteen editions, of which the third was translated into English by M. Eden Paul in 1919. His other anatomical works included contributions to the study of fatty tissue, the structure of the mesentery, the anatomy of the human thorax and the growth of bone. After his retirement he devoted himself to anthropology, his most important work on this subject being on the form of the occiput in the population of southern Germany. He died on November 13, 1920.

Science and the Future of Man

THE social contacts and obligations of science, which was a subject of frequent reference in the proceedings of the recent meeting of the American Association for the Advancement of Science at Columbus, Ohio, notably in the addresses by Dr. Wesley C. Mitchell, retiring president, and Dr. Julian S. Huxley (*see* NATURE, February 10, p. 207, and March 2, p. 330), furnished an important thread in the argument when Dr. Kirtley F. Mather discussed the prospects of human survival in his Sigma Xi lecture on "The Future of Man as an Inhabitant of the Earth". On geological, palæontological and biological grounds he is prepared to allow man a future of probably at least some thousands of years. Even if this present age is an interglacial and not a post-glacial, man's specific adaptability to extremes of climatic environment, he maintained, would enable him to survive. There is, however, he argued, one circumstance which militates against man's prolonged survival. This is the fact that in his conquest of the material world, which is the fundamental characteristic of his recent progress in civilization, man is using up his capital, such as oil, at a far higher rate than he is using his income, that is, the products of natural increase; and a further and even more alarming feature is that that capital expenditure is increasing progressively as the enjoyment of its amenities extends to the less sophisticated peoples. Hence, Dr. Mather concludes, exhaustion of capital in possibly seventy years or less may seriously curtail man's future.

Notwithstanding this depressing outlook, Dr. Mather does not despair of the future entirely in this respect, for he points out that science in its practical application has come to the rescue, and it may be anticipated will do so even more, by the provision of substitutes which will take the place of the capital material now being expended. He gives as an instance the substitutes for the oils, notwithstanding cost, and the same applies to other non-renewable resources. Another consequence of the activities of science in providing substitutes for these capital resources, of even greater topical interest at the moment, is that by liquidating international rivalries in pursuit of the policy of 'grabbing' the sources of supply, science will liquidate the basis of international jealousies and "may make it truly practical to beat our 'swords into ploughshares, our spears into pruning-hooks'." Finally, in regard to the organization of society, Dr. Mather pointed out that in the present rivalry of ideologies, the man of science as citizen must in the future give more thought to the social consequences of his work. He must determine the uses to which the tools he devises may be put, and ensure the wise use of knowledge and constructive application of energy. In a democracy this can be achieved only when the majority of its citizens have the scientific attitude towards social problems and act in accordance with that attitude of mind--a Herculean but not impossible task for education.

Norwegian Fauna

HOSTILITIES in Norway threaten some of the most interesting of European mammals, especially so the large deer, the numbers of which have already been reduced by excessive hunting, and which may be exterminated there as a result of food shortage, just as the European bison was exterminated from many of its European haunts in the War of 1914–18. In Norway, the European moose or elk (locally known as the elg or stordyr) has its strongholds in Sorlandet in the south-east, Ostlandet in the east and Trondelagen in the middle of the country. In some parts of the country it had received total protection by law and in other parts sportsmen were allowed to shoot only a limited number of bull moose during a short season at the end of September. In recent years more than a thousand moose have been shot in Norway in a year, compared with four or five hundred wild reindeer and two or three hundred red deer. There are also roe deer, lynxes and other mammals and a 20,000 acres national park existed for their protection at Sognligaård.

In recent years, Dr. Hj. Broch and the Nature Protection Society of Norway have done much to protect and increase such interesting birds as the osprey, kite, honey-buzzard and hen-harrier, whose nesting numbers were threatened. The 1932 Norwegian game laws protected all owls except the eagle and snowy owls, swans, pheasants, partridges, eider duck, woodcock, and gave a nesting season protection to most useful species. The smew nests in the north of the country, goosanders and mergasers on the waters, puffins, black guillemots and eiders about the rocky coasts, and there are also eagles, brent geese, herons, ravens, crossbills, bullfinches, shrikes, wrynecks, terns and divers. The Scandinavian peninsula has been shown to be the nesting haunt of many of the redwings, fieldfares, common gulls, starlings, wood-pigeons and woodcock visiting Britain in winter. The black woodpecker which nests here has been recorded in Britain on more than twenty occasions, including the last winter, and many ornithologists contend that these may be wild visitors.

Witchcraft in Swaziland

DURING the past week the Judicial Committee of the Privy Council has had before it the appeal of a Swazi subordinate chief, Fakisandhla Nkambule, against a judgment of the Swaziland court, by which he was convicted of having through a witch-doctor procured the death of one of his wives, his brother and his brother's wife. Among the grounds of appeal, it was submitted that the plea of guilty by the witch-doctor had been allowed to prejudice his case. The statements in the case throw an interesting, if somewhat lurid, light on the strength of Swazi belief in witchcraft, which the British administration has for long made strenuous efforts to suppress. It would appear that during the ceremony of placing the ghost rope over a grave to prevent the egress of the ghost, some twenty persons who were present, seated around a cauldron over a fire, partook of 'medicine' into which it is alleged commercial arsenic had been introduced. In the result, it was claimed, three of them had died.

Some hesitation was expressed by the appellant's counsel, Mr. Horace Douglas, in accepting the statement that in Swaziland a rope was believed to be an efficient barrier to a ghost's emergence from the grave; but he was reassured on finding the Greeks and Romans had used rope to keep evil spirits from their houses. Had the learned counsel referred to the works of Sir James Frazer, he would have found ample confirmation in many varied forms. In Swaziland itself the efficacy of the grass rope as a protection against the spirit of the departed is vouched for by the fact that for a certain period the widowed man or woman always wears a grass rope, the 'grave rope', around waist or neck, and this must on no account be removed until the ceremonial period has elapsed.

Austrian Academy in Great Britain

AMONG the thousands of refugees from Central Europe who have arrived in Great Britain during the past eight years or so have been many Austrians, debarred from their own country by their political opinions or by their race. Their numbers have included many eminent scholars, who have been allowed to make their homes in Britain; they feel now that they can discharge a part of the debt of gratitude they owe by contributing to the intellectual life of the country a fuller knowledge of the cultural achievements of Austria. To this end an Austrian Academy in Great Britain has been founded, the honorary president of which is Sir George Franckenstein, formerly Austrian Minister in Great Britain. The Academy is arranging lectures, which will be delivered, as a rule, in English, and will be open to the public, on Austrian culture, and it is hoped to organize exhibitions and other activities in collaboration with the Austrian Circle for Arts and Sciences.

The inaugural meeting of the Academy will be held at the Royal Institution on May 2; among the speakers will be Prof. Gilbert Murray, Prof. E. Schrödinger (for the Austrian Academy) and Sir William Bragg. A "Society of Friends of the Austrian Academy" has been established to collaborate with the Academy and to further its scientific and cultural activities. Members of the Society will be admitted free of charge to all regular lectures, and will have special privileges for other functions arranged by the Academy. The annual contribution is one guinea. Application for membership and subscriptions should be sent to the Hon. Vice-President of the Committee of the Austrian Academy in Great Britain, Baron Guido Fuchs, 15 Portman Square, London, W.1.

Industrial Health in War-time

THE Industrial Health Research Board of the Medical Research Council has published a short report on this subject (Emergency Report No. 1. H.M. Stationery Office. 6*d*. net). It is a summary of research findings, and it is claimed that by adoption of measures recommended, the efficiency, health and comfort of factory workers can be improved, production increased and discontent and fatigue avoided. Recommendations respecting work and fatigue suggest the avoidance of over-long hours and continuous work without intervals for rest, maintenance of Sunday rest and ordinary holidays, alleviation of boredom and elimination of unnecessary movements and effort. For efficient working, sufficient illumination and its proper control and distribution are necessary. Proper heating, the temperature varying with the kind of work, should be maintained, together with adequate ventilation and air movement, and a relative humidity not generally exceeding 70 per cent. A study of the causation of accidents is needed, from which may emerge means for their diminution and prevention. Lastly, recording and analysis of causes of sickness absence and accidents may contribute much information on loss of efficiency and well-being.

Chemistry of Foods

DURING the twelve years in which the Medical Research Council has supported Dr. McCance and his colleagues, the scope of their inquiries has been extended from determinations of the amount of carbohydrate in foods used in the treatment of diabetes to determinations of all the important organic and mineral constituents of foods, with the exception of the vitamins ("The Chemical Composition of Foods". By R. A. McCance and E. M. Widdowson. Med. Res. Council Special Report Series, No. 235. H.M. Stationery Office, 1940). Foods have been analysed, both raw and as prepared for the table, and studies have been made of the losses introduced by cooking.

The present volume includes previously published figures (Reports Nos. 135, 187 and 213), and contains all the quantitative data, in tabular form, likely to be required for work involving detailed knowledge of the chemical composition of British foods. Various facts receive comment. For example, 'Bovril' contained more potassium (3·59 per cent) than any other food examined, parmesan cheese more calcium (1·22 per cent), 'Marmite' more phosphorus (1·89 per cent), carrageen moss more magnesium (0·63 per cent) and sulphur (5·46 per cent), curry powder more iron (0·075 per cent), liver more copper (0·0058 per cent), and Gruyère cheese more nitrogen (5·9 per cent).

Vegetarianism in War-time

So closely is vegetarianism linked in many minds with food 'faddism' that one runs the risk of being regarded as eccentric if the consumption of more vegetables is strongly advocated. Nevertheless, the slogan 'Eat more Vegetables' is not only to form a central feature of the nutritional policy of the Ministry of Food during the War, but also, it is hoped, will be prominent in the post-War campaign to erradicate malnutrition from Great Britain. One simple fact stands out. Wholemeal cereals, vegetables, potatoes and milk or cheese provide all that is required for building a sound body and for maintaining good health. A little book of useful recipes, written primarily, one imagines, for vegetarians, entitled "Food in War-Time" (edited by W. H. White. London: G. Bell & Sons, Ltd., in conjunction with the London Vegetarian Society, 1940. 6*d.* net), should be widely read and used. It describes many dishes which would be valuable additions to our diet in ordinary times as well as in the special times for which it has been written.

Plastic Materials in the *Yankee Clipper*

A LARGE amount of plastic materials is used in the construction and furnishing of the American machines of the *Yankee Clipper* class, used in the trans-Atlantic air service. According to an article in the *Electrician* of March 8, colour plays an important part in the furnishing and decoration of these machines. The average American traveller is very critical of his travel-surroundings, and as he is relatively a prisoner in the machine for long hours on end, it is essential that his liking for cheerful surroundings be satisfied. Plastic decorations have been found to be most useful by the designers.

The dining-room has dome lights made of cellulose and giving a diffused light. The rear compartment, sometimes known as the 'bridal suite', is very luxurious, and is furnished with a dressing-table, etc. The lighting around the dressing-table has shades made of another type of cellulose acetate material. The dressing-table top is of synthetic resin laminated material. On the other hand, the wash-basins and table-tops in the ladies' dressing-room are in a blue vinyl material. The upper wall fabric is protected with sheets of transparent methyl material. Similarly, the cabin windows and the navigator's turret are 'glazed' with methacrylate. Plastic materials are also used for passenger signal flashing lights, for fuel tank gauges, and for some of the control knobs. The walls are made of opaque vitryl resin sheets, differing in colour in the various cabins and departments. Laminated material is used for some of the control pulleys, for spacers of various kinds and for certain bushings, and plastic materials form the basis of most of the paint and lacquer used on the machines.

The National Institute of Agricultural Botany

THE annual report of the National Institute of Agricultural Botany, Huntingdon Road, Cambridge, for the season 1938–39 has been issued. Much of the Institute's work concerns the trial of new varieties of crop plants, and the farmer who takes advantage of the frequent reports issued by the Institute can save himself a considerable amount of time, trouble and expense in trying things out for himself. Many of the notes supplied in the present report relate to types which are still only in the early stages of trial, but are none the less interesting because of that fact. At a time when high production per acre is a question of more than usual importance, the Institute's tests of the ability of certain varieties of wheat to respond to high levels of manuring without lodging will be followed with particular interest. The report indicates that seed of a carefully purified stock of Spratt-Archer barley and of a selected high-yielding strain of Rivet wheat have been recently made available to the seed trade.

Royal Geographical Society Awards

THE King has approved the award of the Royal Medals of the Royal Geographical Society as follows: Founder's Medal to Mr. and Mrs. Harold Ingrams, for their exploration, travel, and studies in the Hadhramaut; Patron's Medal to Lieutenant Alexander R. Glen, for his expeditions in Spitsbergen and North-East Land. The Council has made the following awards: Victoria Medal to Mr. O. G. S. Crawford, for his archæological maps prepared for the Ordnance Survey and his work on the Tabula Imperii Romani; Murchison Grant to Mr. Peter Mott, for his surveys in West Greenland; Back Grant to Mr. Gerald Seligman, for his glacier studies on the Jungfraujoch; Cuthbert Peek Grant to Mr. John Hanbury-Tracy, for his work in south-eastern Tibet with Mr. Kaulback and his journey in the north of South America; Gill Memorial to Mr. Alexander King, for his work in Jan Mayen in 1938.

Lectures on Food and its Use

A SERIES of lectures under the general title "The Nation's Larder" have been arranged at the Royal Institution with the approval and support of the Ministry of Food. The first was delivered on April 23 by Prof. J. C. Drummond, who spoke on food in relation to health in Great Britain during the past two hundred years. The remaining lectures of the series, which are being given on Tuesdays at 5.15, are on medical aspects of the use of foods (Sir Robert McCarrison), national food requirements (Sir John Orr), home production of food (Sir Frederick Keeble), manufacture, preservation and distribution of food (Dr. L. H. Lampitt), food and the housewife (Prof. V. H. Mottram) and the feeding of children (Dr. J. C. Spence). The lectures are to be published later in book form. Admission is by ticket obtainable, free of charge, from the Royal Institution, Albemarle Street, London, W.1.

Eighth American Scientific Congress

AN illustrated descriptive programme is now available of the Eighth American Scientific Congress, to be held in Washington, D.C., during May 10–18 (see NATURE, December 23, 1939, p. 1056). The Congress will be opened by President Roosevelt on May 10; and the first plenary session takes place on May 13.

Sectional meetings of the eleven sections occupy the remainder of the week, and the final plenary session will be on May 17. Government delegates of the other American Republics will be entertained by the United States Government at an official luncheon and at a banquet. The headquarters of the Congress will be at the Pan American Union, Washington.

Recent Earthquakes

ON April 13 there were further aftershocks of the Anatolian earthquake of December 26, 1939, in the region originally affected. The shocks were strong and felt as far away as Ankara. Great damage was caused to fifteen villages, six being completely destroyed. Sixteen persons were injured and four children are believed to have been buried beneath the wreckage. In the Caucasus, according to a report in *The Times*, the River Kars has overflowed, causing damage to the town of Kars. It is conceivable that with such extensive disasters as Turkey has recently suffered there may be some ground tilting even as far distant from the scene of the original disaster as the Caucasus.

On the night of April 17, a severe earthquake was experienced at Patras at the entrance to the Gulf of Corinth and to the north of the Island of Morea. No information is available as to the damage caused, if any, at the time of writing. The earthquake was felt in the Agrinion district, and more severely in the Missolonghi district, where in 1824 the poet Byron died fighting for Greek independence. It is well known that minor earthquakes are common in Greece, and destructive ones are by no means uncommon. It will be remembered that on April 22, 1928, at about 20h. 14m. G.M.T., a severe earthquake somewhat to the north of Corinth partly destroyed that city. More information is required before the epicentre of the present shock can be accurately determined.

The Night Sky in May

BY the middle of May, the night (sunset to sunrise, London) is of 8½ hours' duration. The moon is new on May 7 at 12h. and full on May 21 at 13h. Mars is in conjunction with the moon on May 10 and Venus on May 11. Jupiter and Saturn are now both morning stars but too close to the sun for observation. Venus is the brilliant evening star, setting less than one hour before midnight U.T. (that is, 1h. summer time). Its greatest brightness is reached about May 20, when its magnitude is $-4\cdot2$. Under favourable atmospheric conditions, it should be possible to see the planet in the daytime. Its time of meridian passage and altitude is given for May 5, 12, 19 and 26 —15h. 3m. (65·8°), 14h. 58m. (65·7°), 14h. 49m. (65·2°) and 14h. 35m. (64·5°). A telescopic view of Venus at this time will show the planet as a crescent, $\frac{1}{3}$ full in the middle of May and $\frac{1}{5}$ full at the end. Venus, with respect to size and mass, is almost the twin of the earth. A dense atmosphere evidently surrounds the planet and screens its surface from observation. Direct telescopic scrutiny shows almost a complete absence of markings, but ultra-violet photographs have recorded belts and bright spots which are probably high-level phenomena. Thus the rotation period of the planet remains in doubt, though probably one rotation takes nearly a month. Venus is the cynosure of the western evening sky, but as night comes on a glance may be spared for the stars Capella, Procyon, Castor and Pollux in the west; Regulus and Arcturus on the opposite side of the southern meridian; Spica low in the south, while Vega is above the north-eastern horizon. About May 4, members of the Eta Aquarid meteor shower (believed to be associated with Halley's Comet) may be seen in the early morning. On May 25, the 4th magnitude star, ρ Sagittarii, is occulted by the moon, the disappearance as seen from Greenwich taking place at 1h. 23·1m. at 90° from the north point of the moon's image; the reappearance being at 2h. 40·9m. at position angle 253°.

Announcements

DR. STANLEY B. BAGLEY has been elected president of the Society of Glass Technology in succession to Dr. C. J. Peddle.

IT is announced in *Science* that Prof. F. Joliot and Madame Irene Curie-Joliot, co-workers in the Radium Institute, Paris, have been awarded the 1940 Barnard Gold Medal for "meritorious service to science" bestowed by Columbia University every five years. The medal was established by the will of Frederick A. P. Barnard, president of Columbia during 1864–1889, and is awarded "to the person, if any, whether a citizen of the United States or any other country, who within the five years next preceding has made such discovery in physical or astronomical science, or such novel application of science to purposes beneficial to the human race, as in the judgment of the National Academy of Sciences of the United States is esteemed most worthy of such honor".

IN future the identification tag that every soldier in the German army must wear round his neck must indicate the blood group to which he belongs.

MIGRATION during 1939 increased the population of Australia by 12,537 persons, 1,636 of these being British. German nationals—almost all refugees—numbered 4,857. The gain to Australia of British migrants is the largest since 1929, when the depression stopped assistance to immigrants.

ACCORDING to *La Riforma Medica* of February 10, the annual birth-rate per 1,000 inhabitants in the chief capitals is as follows: Rome, 22; Buenos Aires, 18; Copenhagen, Budapest and Amsterdam, 15; New York, Berlin and London, 14; Warsaw, 13; Paris and Stockholm, 11; and Brussels, 10.

ERRATUM. NATURE, January 27, p. 148, letter entitled "First Benedicks Effect in Gas-free Mercury, as Influenced by tho Mean Temperature", for the formula $u = \mathrm{K} \,.\, \frac{3}{\Delta t}$ read $u = K \,.\, \overline{\Delta t}^{3}$.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

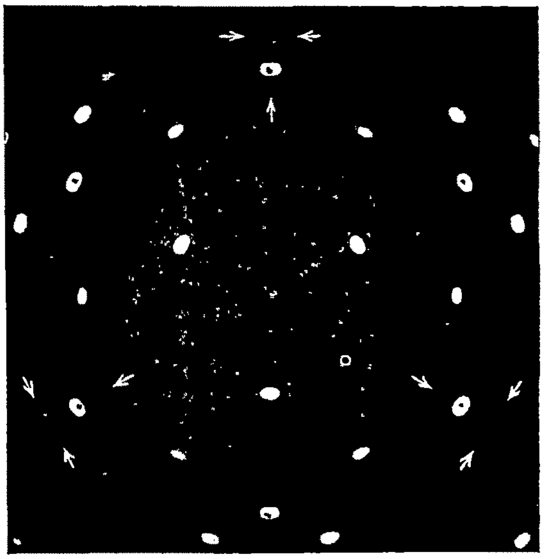
In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Notes on points in some of this week's letters appear on p. 673. Correspondents are invited to attach similar summaries to their communications.

Specular Reflection of X-Rays by High-Frequency Sound Waves

The principle that a regularly stratified medium selectively reflects a monochromatic beam of radiation incident on it at the appropriate angle is well known and forms the basis for the X-ray analysis of crystal structure. The spots appearing in a Laue diffraction pattern are, of course, due to such selective reflections of the incident X-rays by the periodic stratifications which represent the static structure of the crystal. A specular reflection of X-rays may, however, also result from stratifications of density which are not static but dynamic in character, and which may be considered as equivalent to stationary sound waves of very high frequency. We have observed and studied numerous examples of this special kind of X-ray reflection, but will content ourselves here with giving a single illustrative example chosen for its simplicity.

The accompanying reproduction represents the Laue pattern due to a crystal of diamond which has the form of a plate with faces parallel to an octahedral cleavage of the crystal, and through which passes a narrow pencil of X-rays from a tube with a copper anticathode and nickel filter. The pattern, as is to be expected, shows trigonal symmetry, the three spots marked with radial arrows in the figure being the reflections from the (111) planes, which are inclined to the trigonal axis at an angle of 19° 28′. Three other spots (indicated by tangential arrows) are also noticeable in the figure. The sharpness of these spots shows them to be specular reflections, but they are clearly not Laue spots, as is to be seen from the difference in their shape, as well as from the fact that there are no planes in the crystal which could give rise to reflections in the directions observed. These auxiliary spots must therefore be explained as arising from stratifications of density in the crystal which are of a dynamic nature.



Laue pattern of diamond along a trigonal axis (copper K_α radiation).

The origin of these spots becomes clear when we consider the effect on the structure of the diamond of its characteristic internal vibration. This is a periodic movement of the two interpenetrating lattices of carbon atoms with reference to each other in any arbitrary direction and with a very high frequency corresponding to 1332 cm.$^{-1}$ in spectroscopic units. If this vibration has a direction normal or nearly normal to an octahedral cleavage face of the diamond, stratifications of density are induced which vary periodically with time and have a spacing equal to that of the (111) planes in the crystal, but with an orientation variable within wide limits. These stratifications are therefore in a position to give a selective reflection of the monochromatic copper K_α radiation present in the incident pencil of X-rays. The observed position of the spots is in agreement with that calculated from the known spacing and wave-length. The explanation indicated is further confirmed by the fact that, using unfiltered radiations, we get two spots in each case, corresponding to the copper K_α and K_β radiations, and occupying distinct positions, as is to be expected.

We shall return in another communication to various other aspects of this new type of X-ray reflection.

C. V. Raman.
P. Nilakantan.

Department of Physics,
Indian Institute of Science,
Bangalore.
April 3.

Barometric Co-efficient of Extensive Cosmic Ray Showers

Counter experiments, intended to measure the rate of shower-producing radiation associated with extensive showers at sea-level, have given us an opportunity of measuring the barometric effect of showers up to 20 metres in mean diameter.

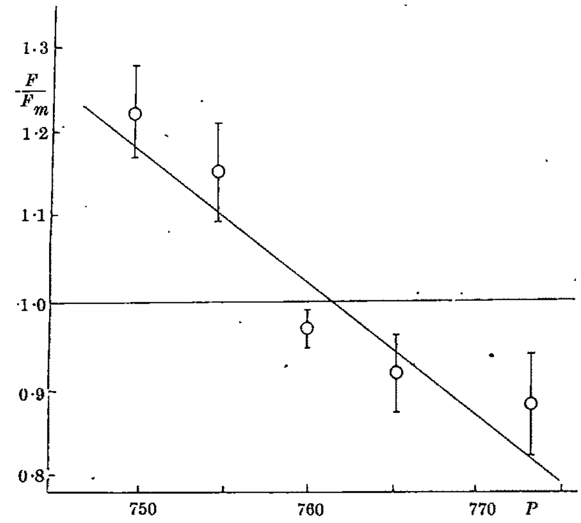


Fig. 1

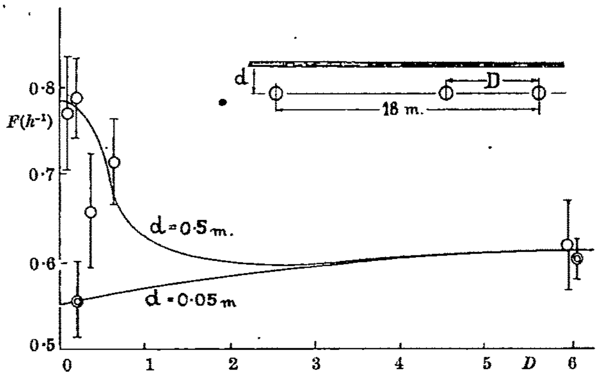


Fig. 2

We found that the barometric coefficient increases quickly with the diameter of the showers: for a barometric variation of 1 cm. of mercury, we found a corresponding variation of the frequency of showers of 4–5 per cent for 0·3 metre diameter showers: 8 ± 3 per cent for showers 12 metres in diameter, and 16 ± 3 per cent for showers 18 metres in diameter.

The measurements were made by means of a set of three counters, each of 120 cm.^{2} effective cross-section, under or above a thin tile roof.

Fig. 1 refers to a continuous run of four months, with daily recording. (D = 18 m.)

Comparison between measurements above and at different distances under the tile roof shows that, at sea-level, an important part of the soft rays associated with 20 m. showers are produced in the roof as ordinary secondary showers.

This is clearly shown in Fig. 2, which demonstrates the secondary coherence of most of the rays. No such increase was observed above the roof.

Thus, the distribution of rays in space follows closely the Poisson law above the roof and at several metres beneath; but the proximity of the roof introduces a secondary coherence between the rays. This explains the apparent discrepancy between the results of Auger[1] and those of Janossy and Lovell[2], for even a thin roof produces a large secondary coherence.

More experiments, now in progress in our laboratory, are needed before trying to reach quantitative conclusions.

Max G. E. Cosyns.

Physical Laboratories,
Fondation Medicale Reine Elisabeth,
Brussels.
March 8.

[1] Auger, P., and Maze, R., *C.R. Acad. Sci.*, **207**, 671 (1938).

[2] Janossy, L., and Lovell, A. C. B., Nature, **142**, 716 (1938).

Volume Integration of Dosage for X- and γ-Radiation

In radiation therapy as practised in this institution at the present time, the underlying principle adopted in the planning of treatment is to give a uniform tumour dose between 4000 r. and 6000 r. To achieve this, in deep-seated lesions, a multiple field technique has to be employed, and much radiation is absorbed which contributes not to the destruction of the tumour itself but to that of the normal tissues of the body. In the following note, methods are given for integration of dosage in a volume through which a beam passes.

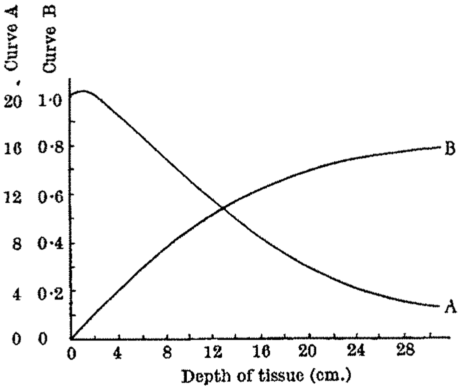
If at any point in a volume V, r is the dose of radiation in roentgens, then in that volume the integrated radiation dosage R is given by

$$R = \int_0^V r.dv, \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where R is measured in E.S.U. of charge.

To evaluate R. (*a*) In a series of complete isodose curves[1], the integrated radiation dosage can be evaluated graphically; the results of this method of calculation will be published in detail elsewhere. The few results already obtained are in agreement with the theory of section (*b*).

(*b*) In the case of radiation from a point source



Curve A : $\frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2}$

Curve B : $\int_0^x \frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2} . dx$

(for the purposes of the following discussion the X-ray beam considered is that from a 200-kv. Metropolitan-Vickers X-ray tube filtered through 1 mm. copper, 1 mm. aluminium at a focal skin distance of 40 cm.)[2], a simple method of computation of R has been evolved and the results are given below.

Curve A in the graph shows how the central ray of a large application (20 cm. × 15 cm.) is absorbed if its original area is 1 cm.^{2} at the surface of a 'water phantom'. The ordinates are the product of the depth dose[1] r and the geometric cross-section of the beam $\frac{(40+x)^2}{40^2}$ expressed as a fraction of the maximum incident skin dose r_0. in a solid angle of $1/40^2$. The final expression is $\frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2}$, where x is the thickness of absorbing material. The area enclosed under the curve gives the ratio of the integrated dosage and the saturated skin dose per cm.^{2} of incident radiation, that is, $\int_0^x \frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2} \cdot dx$. The integrated dosage for any depth of tissue can be calculated from curve B as the product

$$R = Ar_0 \int_0^x \frac{r_x}{r_0} \cdot \frac{(40+x)^2}{40^2} \cdot dx, \quad . \quad . \quad (2)$$

where A is the area of the applicator. This holds equally for all areas of irradiation and r_0 remains constant, being the maximum skin dose for a large applicator. For large fields, however, A represents the area of the spherical surface instead of its tangential plane, and if flat filters are used a correction is also required for oblique filtration at the edge of the beam.

From the graphs an approximate working formula for volume integration of dose may be obtained, for thickness of absorbing material x is greater than 5·6 cm. (exponential absorption only occurs after a depth of 5·6 cm.)

$$R = Ar_0 \times 5{\cdot}6 + \frac{Ar_0}{\mu}\left(1 - e^{-\mu(x-5\cdot6)}\right), \quad . \quad (3)$$

where μ is the absorption coefficient 0·085 cm.$^{-1}$.

This method can be applied also to point sources of γ-radiation, but in the case of radium beam therapy[3], where the source is not a point, the method of section (*a*) has to be applied. It is proposed to deal more fully with the problem of integrated dosage at a later date.

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March 18.

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The Cyclol Hypothesis

Five sets of experiments have been reported in the past few years which have been claimed to bear on the cyclol hypothesis.

In a study of the infra-red spectrum of crystalline diketopiperazine, Kellner[1] found that the molecule is not in the enol form and is entirely or for the most part in the *lactam* rather than the *lactim* form. It is difficult to see the relevance of this result to the cyclol hypothesis, which has nothing to say as to the structure of such molecules.

It has been suggested that the study of the conditions under which CO–NH groups polymerize (dimerically to give double peptide bonds and trimerically to give triple peptide bonds) may prove to be a fruitful approach to protein synthesis[2]. The fact that α-piperidone is found to be monomeric in water and dimeric in benzene[3] does not conflict with this suggestion, which I desire to re-emphasize. Still less does it provide any evidence against the cyclol hypothesis, as has been claimed[4]. It seems in fact illegitimate to state, on the basis of these experiments, that "two experiments designed to test the cyclol hypothesis failed to support it"[5]. It has yet to be demonstrated in which respects, if any, diketopiperazine and α-piperidone can be regarded as models for the protein, or even as throwing any light on protein structure.

Analogous considerations apply to the unsuccessful attempt of Meyer and Hohenemser[6] to obtain *l*-leucyl, *l*-leucine and glycol glycine by mixing *l*-leucyl glycine and glycyl *l*-leucine. In this investigation no evidence was offered that a triazine intermediate was formed; the cyclol hypothesis does not require that dipeptides should form a triazine; had it been formed, the cyclol hypothesis does not require that it should break down into the dipeptides referred to. This experiment has in fact no relevance to the cyclol hypothesis.

The spectroscopic observations of native and digested serum by Haurowitz and Astrup[7] have also been cited as evidence against the cyclol hypothesis[4]. Here I need only direct attention to the work of Holliday, of which a preliminary account has recently been given[8]. It is necessary, in his opinion, before using such observations as arguments for or against the cyclol hypothesis, to distinguish change of absorption of the aromatic amino acids from the appearance of new absorbing centres.

A striking point of divergence between the classical and cyclol theories is the replacement of some or all of the skeletal CO and NH groups in the former by C(OH)–N groups in the latter[2,9]. In an attempt to settle whether or not the postulated cyclol OH groups occur in the native protein, Haurowitz[10] has studied experiments on the methylation and acetylation of proteins in which reagents such as acetic acid, acetyl chloride, acetic anhydride, dimethyl sulphate, diazomethane, ketene, etc., were used. His experiments, which repeat the results of the previous investigators, show that such OH groups, if present, are apparently not acetylated when the protein (egg albumin) is boiled (in the absence of a catalyst) with acetic anhydride, and are not methylated when the protein (egg albumin, horse hæmoglobin) is treated with dimethyl sulphate.

From these and the previous experiments, Haurowitz draws the conclusion that no cyclol OH groups exist in the native protein. But it is, in fact, very doubtful whether any conclusions regarding the presence or absence of these groups can be drawn from these negative findings. To do so it is necessary to assume that during these experiments the fine structure of the native protein remains intact, a very doubtful premise. Even if this assumption be made, it is further necessary to assume that the techniques used would certainly methylate or acetylate the cyclol OH groups, if they were present. In view of the fact that few $\geq$C–OH groups are at present known whose atomic environment bears any resemblance to that in the cyclol fabric, any such prediction seems dangerous. In point of fact, the nearest analogues to the cyclol $\geqq$C–OH groups seem to be those in the 1,3,5-trimethyl-2-phenyl (or alkyl)-2-hydroxy-4, 6-dioxohexahydrotriazines recently synthesized[11]. These compounds, it was found, are inert towards diazomethane and phenylisocyanate. These facts, *inter alia,* show that it cannot be dogmatically asserted that the cyclol OH groups, if present, would respond to the reagents listed above. In consequence, the negative findings under discussion go no way at all to proving the non-existence of the special type of skeletal OH groups postulated on the cyclol hypothesis.

Implicit in much of the criticism directed against the cyclol hypothesis is the curious argument that the fact that the cyclol structures contain features new to organic chemistry in itself constitutes evidence against the hypothesis[4]. This fact necessarily makes it difficult and probably impossible to test the hypothesis by such techniques as methylation and acetylation, even if difficulties relating to denaturation prove surmountable. However, since proteins have not yet been synthesized, and since they constitute a class of compounds which in many respects has unique qualities, the argument seems (if significant at all) to be in favour of the hypothesis. Failure to synthesize what have been called "simple substances with cyclol structure"[4] (a phrase which may prove to be a contradiction in terms) is also no evidence against the hypothesis. Criticisms of this type overlook the fact that all known proteins having molecular status contain thousands of atoms per molecule, and are by no means restricted in their constituents to one or two types of amino acids.

It appears then that the criticisms discussed above—in particular the five experiments—provide no evidence against the cyclol hypothesis. No statement of the case for the hypothesis is necessary, since an authoritative account[12] has already been given of the way in which it satisfactorily explains many of the well-known properties of the native proteins.

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Maryland, Feb. 25.

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Demonstration of Thermal Diffusion in Liquids

CONSIDERABLE attention has recently been paid to a separation method for gases and liquids, which involves thermal diffusion and syphon action. In particular, the experiments of Clusius and Dickel[1] with carbon dioxide – hydrogen, and bromine – helium mixtures may be mentioned, while promising results in the separation of isotopes have also been reported[2]. Further, the same method gives good separations with aqueous solutions of inorganic salts[3] and mixtures of organic liquids[4].

Simple apparatus for illustrating these separations in the case of solutions has been constructed as follows. The solutions were enclosed by means of short rubber tubes within the vertical annular space between two concentric glass tubes. The diameter of the inner tube was 7 mm., its length 150 cm., and the annular space 0·5 mm. in thickness. Cold water was passed through the inner tube and steam through a surrounding jacket. With a solution of copper sulphate containing 330 gm. per litre, almost complete disappearance of the blue colour, indicating, therefore, a marked reduction in concentration, was observed at the top of the apparatus after eight hours treatment, while increase in concentration was sufficient to induce crystallization at the bottom of the tube.

A second apparatus, in which the annular space was only a few tenths of a millimetre in thickness, gave rapid separations with copper bromide and with cobalt chloride. The former is brown in concentrated and greenish blue in dilute solution, while the latter gives a blue colour in moderately concentrated hydrochloric acid which, on dilution, reverts to the characteristic pink. With initial solutions of intermediate tint, the anticipated colour changes clearly developed in the upper and lower sections of the tube in each case within two to three hours.

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MOWBRAY RITCHIE.

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Sirius and the Constellation of the Bow

THERE is rather a remarkable coincidence (if it is a coincidence) in connexion with the ancient constellation figures to the south-east of Sirius, occurring in Babylonia, China and Egypt.

In the Chinese "Star Classic", reputedly of the third or fourth century B.C., but reassembled in the ninth century A.D., there is the phrase "The Bow and Arrow are nine stars to the south east of the Wolf" (the Wolf is Sirius)[1]. Schlegel shows in his diagram the arrow pointing towards Sirius, which might even be regarded as the tip of the arrow.

In Babylonia "in the late period Kaksidi [Sirius] was imagined as an arrow. Behind it stood the constellation Bow. Sirius is the shining point of the arrow; presumably one or more stars between this and the bow marked the shaft"[2].

On the Denderah round 'zodiac' from the small temple on the roof of the Great Temple of Denderah, now in the Louvre, there is a figure just to the left (east) of the Cow in the Barque (Sirius) which represents the goddess Satet bearing a bow and arrow[3].

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Acetyl Content of Marinobufagin, Arenobufagin and Acetyl-marinobufagin

For marinobufagin, first isolated by Abel and Macht[1] from *Bufo marinus* and afterwards by Deulofeu and Mendive[2] from *B. paracnemis*, Slotta and Neisser[3] suggested the formula $C_{27}H_{38}O_6$, at variance with $C_{24}H_{32}O_5$ accepted by Jensen in many of his papers. They supposed that marinobufagin could contain one propionyl group.

The determination of the volatile acid content of several samples of marinobufagin by the Kuhn and Roth method[4] has given values lower than 1 per cent, so that acetyl or propionyl groups seem to be excluded from its constitution. Analysis of the samples gave carbon and hydrogen values according with Jensen's formula $C_{24}H_{32}O_5$.

When the same method was applied to acetyl marinobufagin[5], the acetyl content was found to be about 18 per cent, pointing to two acetyl groups in the molecule (calculated 17·76 per cent). Two easily esterifying alcoholic groups seem to be present (primary or secondary). On the basis of its elementary analysis, acetyl-marinobufagin has always been considered a mono-acetyl derivative. This difference will be further investigated.

From *B. arenarum*, Chen, Jensen and Chen[6] isolated a substance melting at 220° (correct.), to which formula $C_{25}H_{34}O_5$ was assigned. Jensen[7] states that the acetyl group is present, as by alkali hydrolysis acetic acid was detected as the silver salt.

We have isolated from the crude venom of *B. arenarum* another compound melting at 231–233° with a formula $C_{24}H_{32}O_6$ (elementary analysis) and without acetyl group (less than 1 per cent). Only further research on both compounds will explain the relationship between them.

That the method employed for the determination of acetyl groups is reliable results from the work of Wieland, Hesse and Hüttel[8] on bufotalinine, where correct acetyl values were obtained.

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March 5.

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Substrate Specificity of Yeast Zymase

In a recent paper[1] further and seemingly conclusive proof was given that hydrolysis of maltose to glucose is not a necessary condition of maltose fermentation by living yeast cells. It may be noted that one of the findings upon which this conclusion was rested has now been independently confirmed[2]. Results since obtained suggest that not only is the mechanism of maltose fermentation *in vivo* different from, but also that it is not inclusive of, the glucose fermentation mechanism.

(1) It has been found that maltose fermentation by maltase-poor baker's yeast is strongly inhibited by the presence of methyl α-glucoside, but that under the same conditions glucose fermentation is unaffected.

The inhibiting action is not due to an inhibition of maltase since fermentation by maltase-rich brewery yeast and hydrolysis by maltase preparations of either baker's or brewery yeast are not subject to inhibition by methyl α-glucoside under the same conditions. It follows, therefore, that the mechanism of maltose fermentation includes a component which is not present in glucozymase and is not maltase.

(2) Conditions have been realized in which maltose ferments more rapidly than glucose. It is known that in aqueous or dilutely buffered medium, brewery yeast may ferment maltose and glucose at about the same rate. High salt concentrations depress the fermentation-rate of both sugars but have been found to do so more markedly in the case of glucose. The fermentation rate ratio of maltose to glucose in concentrated solutions of phosphate-citrate or other buffer salts may still be near 1·0 when fresh yeast is used, but far exceeds 1·0 when yeast which has been allowed to age is used.

The markedly superior fermentability of maltose in high buffer concentrations is proof that maltozymase is not merely maltase plus glucozymase. The same finding also offers support, though it does not itself constitute conclusive proof, for the view that maltozymase does not include glucozymase.

This conclusion is not opposed to any known fact of maltose fermentation, and finds further support in several observations which reveal primary differences in the fermentation mechanisms of maltose and glucose[3,4,5]. Also it should be mentioned that the *p*H-activity curve of maltose fermentation by baker's yeast is not given by glucose, and, as has been confirmed by us, is essentially different also from the *p*H-activity curve of either cell-bound or free yeast maltase[2,1].

The question may therefore be put whether the time-honoured term 'alcoholic fermentation of sugar' does not in fact cover processes which are different for different substrates.

It is intended to give a fuller discussion of this problem, details of the present experiments and a report of experiments on the alcoholic fermentations of sucrose, raffinose, and lactose in a later paper.

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March 10.

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A Decalcification Fluid

Since my former communication[1], I have had opportunity to conduct a number of experiments with the sodium hexametaphosphate decalcifying fluid reported.

Using the formulæ given by Gray[2], I find that a 25 per cent solution of the sodium hexametaphosphate is miscible in all the basal fixing solutions mentioned, except those containing alcohol. I have not been able to test the platinum chloride ($PtCl_2$) solution. With alcoholic solutions, the sodium hexametaphosphate apparently forms an emulsion which separates out in a short time. This immiscibility with alcoholic solutions is no great drawback, since all of the usual fixatives containing alcohol also contain acetic acid. The object of the sodium hexametaphosphate is to avoid the 'gasing' caused by acid fixatives when used on calcareous material, and hence, as a rule, these would not be used. Chromic acid fixatives do not cause appreciable gasing, and can be used to advantage.

To those fixatives which in Gray's paper are prepared by the addition of a large volume of water to the basal fixing solutions, I recommend adding instead the same volume of 25 per cent sodium hexametaphosphate solution. In other cases, the solution can be added as an addition to the normal fixative. In all cases where the material is in reasonably small pieces, decalcification takes place in the normal period of fixation.

I find also that the sodium hexametaphosphate solution is miscible with the usual solutions used for washing after fixation.

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March 24.

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[2] *J. Roy. Micro Soc.*, 53 (1933).

Carcinogenic Colouring Matters

PROF. J. W. COOK's article on "Cancer-Producing Chemical Compounds" published in NATURE of March 2 raises questions of extreme importance for all those who employ artificial colouring matters in the manufacture of articles intended either for internal consumption or for application to the skin, or whose business it is—as in my own case—frequently to have to give advice about suitable colouring matters to use for either of these purposes.

May I suggest that it is highly desirable that a full report of the experiments mentioned by Prof. Cook should be published, and that the work should be continued ?

Prof. Cook's reference to a "limited range" of "permitted" food colouring matters in Great Britain is both puzzling, and, I venture to suggest, misleading. In Great Britain, unlike the United States of America, certain of the Dominions, and various other countries, there is no list of "permitted" food colouring matters. The use of certain metallic colouring matters, one colouring matter of vegetable origin (gamboge), and five specified coal-tar colours, is forbidden. These apart, food and beverage manufacturers are free to use any colouring matters they like so far as they are not injurious to public health.

A fairly considerable range of colouring matters is manufactured by firms specializing in the production of colours for the food industries. These include several azo-compounds, all of which are not sulphonated. Among the latter, special mention may be made of Yellow AB (benzene-azo-beta-naphthylamine), and Yellow OB (orthotoluene-azo-beta-naphthylamine). According to work reported by Prof. Cook, these two colouring matters should be regarded with suspicion ; but they are "permitted" colours in the United States, where legislation is far more stringent in the matter than in Great Britain.

There is a fairly general impression that toxicity of dye-stuffs is, at least in many cases, reduced or destroyed by sulphonation, which, at the same time, converts the substance from an oil-soluble dye into a water-soluble one. It is highly desirable to know, I suggest, whether this process also destroys any carcinogenic properties.

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March 18.

A FULL report of the experiments on the carcinogenic properties of 2 : 2′-azonaphthalene and its transformation products, and of the tests carried out on certain food colouring matters, to which reference was made in my recent article, is at present being prepared for publication. These experiments form part of an extensive series carried out by Prof. E. L. Kennaway and myself, with our collaborators, in the research laboratories of the Royal Cancer Hospital (Free), London.

I agree with Mr. Redgrove that my reference to "permitted" food colouring matters in Great Britain is a misrepresentation. Changes in my circumstances had deprived me of access to a correspondence which I had with the Government Chemist in 1936, when the tests with food colouring matters were begun. I have now been able to consult this correspondence and it is clear that the reference in my article to tests carried out with "a selection of these permitted dyes" should have read "a selection of the relatively few dyes in common use as food colouring matters".

The unsulphonated dyes mentioned by Mr. Redgrove undoubtedly require, and will receive, further attention. I was not aware that Yellow AB and Yellow OB are used in the food industries, and from inquiries which I have now made it would appear that these dye-stuffs are very little used in Great Britain.

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High Proportions of Homostyle Plants in Populations of *Primula vulgaris*

As part of a study of heterostyly in Primula, with particular reference to the fertility relations existing between the two normally occurring types, pin and thrum, counts of their proportions in natural populations have been made. My own data have been supplemented by some counts made by friends and colleagues in various parts of Britain.

By far the most striking of the populations of *P. vulgaris* so far discovered are some from Somerset. I received from Miss M. Ll. Jones a collection of flowers, one taken from each plant selected at random in Sparkford Wood. Out of a total of 323, 102 were pins, 11 were thrums, and 210 were long homostyles, that is they had the anthers in the thrum position, while the style was long with the stigma in the pin position. A few stigmas were examined microscopically, and they all had long papillæ.

There are further counts from the same district made by Mr. P. B. Pitman, but in none of these have I examined the flowers. In an area of Sparkford Wood, slightly overlapping the first, the proportions found were 145 pin, 15 thrum, 468 long homostyles. It appears that the population within the wood is far from uniform, and is thus not likely to be even approximately in a state of stability. In another wood about five miles away, 152 pin, 103 thrum, 177 long homostyles were found. In contrast to these, a count on two banks near Maperton, in the same district, showed 46 pin, 75 thrum, 7 long homostyles, and 41, 40, 2 respectively.

Three styles from the Sparkford flowers were dissected and stained, and it was found that the pollen which was on the stigma had grown well. The grains were large, of the thrum type, and because of the shortage of thrum plants in the wood may be assumed to have come from a long homostyle flower. The fact that the stigma is usually more or less in contact with the opened anthers makes it reasonable to assume that self-pollination is the rule in homostyle plants. Further, experiments with a long homostyle *Primula veris* in 1939 showed that it was quite self-fertile.

It seems likely, therefore, that long homostyles in *P. vulgaris* are always self-fertilized. If such plants appear in a population, their fate depends upon the viability of the homostyle homozygote. If it is inviable, the gene combination responsible for homostyly would be eliminated from the population if thrums were present; if only pins and long homostyles occur, then at stability these will be present in the ratio $1 : \sqrt{2}$. If the homostyle homozygotes are viable, the ultimate population should consist entirely of them.

If, then, a long homostyle appears in a normal population, it should spread, provided the homozygote is viable; thrums should decrease more rapidly than pins, but both forms should ultimately disappear. The striking heterogeneity in the counts from different populations in the same area would seem to be due to different stages in the evolution of a new state of stability in each population following the appearance of long homostyles in that district. It is possible that further counts in the same district might reveal an orderly heterogeneity of the populations, with a centre of high homostyle concentration surrounded by populations with concentrations decreasing with distance from the centre. That is, one might expect that the gene combination responsible for homostyly would migrate outwards from its point of origin.

Further data must be obtained upon the occurrence of homostyles in natural populations. The facts communicated above show that in the counting of Primula populations it is important that all plants should be examined both for anther position and style length; long homostyles in which the stigma is not readily visible will resemble thrums until the corolla is removed.

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April 17.

Points from Foregoing Letters

A LAUE pattern of diamond along a trigonal axis submitted by Sir C. V. Raman and P. Nilakantan shows additional sharply defined spots, which are believed to arise from dynamic stratifications of density in the crystal.

M. G. E. Cosyns finds that the barometric coefficient of extensive cosmic ray showers increases rapidly with the diameter. The particles of the extended shower produce numerous secondaries in even a thin roof, and these secondaries may account for anomalies in previous results on these showers.

A method has been devised by F. Happey for the calculation of integrated radiation dosage by considering the absorption of a saturated solid angle of beam of X-rays from a point source, and the results are expressed in a form which can be used clinically. A graphical method is also indicated for use with X- or γ-radiation.

D. Taylor and M. Ritchie describe some results obtained with a simple apparatus for demonstrating the Clusius-Dickel thermal diffusion effect in aqueous solutions. Striking colour changes in the upper and lower sections of solutions of copper sulphate, copper bromide and acidified cobalt chloride, jacketed in a long annular space between hot and cold surfaces, are very readily obtained.

For marinobufagin, the active principle from the venom of *B. arenarum*, the formula $C_{24}H_{32}O_5$ proposed by Jensen has been confirmed, but the acetyl derivative usually accepted as a mono-acetyl compound gave acetyl values that agree with a di-acetyl compound. From *B. arenarum* secretion a substance melting at 231–233°, and with formula $C_{24}H_{32}O_6$, has been isolated. It contains no acetyl, and it is different from the arenobufagin of Chen, Jensen and Chen.

It has been found by J. Leibowitz and S. Hestrin that by selective inhibition of the glucose fermentation rate through high salt concentrations, conditions could be realized in which brewery yeast fermented maltose far more rapidly than glucose. It is therefore concluded that maltozymase is not merely maltase plus glucozymase, and probably does not contain glucozymase.

Sodium hexametaphosphate, formerly reported by R. A. C. Wilks as a decalcifying agent, is miscible with all the usual fixatives, except those containing alcohol. Hence decalcification can take place at the same time as fixation, thus effecting a speeding up of these preliminary processes.

H. S. Redgrove stresses the importance of continuing the investigation on cancer-producing chemical compounds referred to by Prof. J. W. Cook in a recent article in NATURE, more especially in view of the use of azo dyes and derivatives of beta-naphthylamine for colouring foodstuffs and cosmetics. He points out that there is no list of 'permitted' colours for use in foodstuffs in force in Great Britain.

J. L. Crosby reports the occurrence in Somerset of populations of *Primula vulgaris* with very high proportions of long homostyles, and a considerable shortage of thrums as compared with pins. The effect of the appearance of such homostyles in populations consisting only of the normal forms is briefly discussed.

RESEARCH ITEMS

Measurement of the Nasion in the Living

Owing to the importance of determining the nasion in the living and the difficulties of so doing, special directions are given by the various authorities; these have been discussed and compared with his own elaboration of method by K. P. Chattopadhyay (*Amer. J. Phys. Anthrop.*, **25**, 2; 1939). Martin recommends light pressure with the lateral edge of the thumb up and down on the skin in the neighbourhood of the root of the nose, while Hrdlička, though also recommending the finger-nail or the point of a pencil, relies in the majority of cases on the experience of observation on skulls and dissecting room material. Lipiec and Oetteking worked on cadavera and skulls, and Ashley-Montague carried out experiments on "freshly-deceased human cadavera" with the purpose of their extension to the living, confirming his results by X-ray studies of ten living adult white males. But as the position of the superior palpebral sulcus, as used by Ashley-Montague as a point of departure of his horizontal tangential intersecting the mid-sagittal plane, has no constant relation to the nasion, a different approach has been tried. Ninety skulls of Bengal Hindus and twelve others in the University and Indian Museum were first studied, taking the distance between nasion and the intersection of the common tangent to the superior margin of the two orbits with the mid-sagittal plane. The mean value (all skulls) was found to be 5·311 mm. This method was adapted to conditions in the living whose nasal suture could be determined by palpation, by using caliper or tape and steel plate, with the tangent to the arched grooves when the eye is wide open as the line of reference. The result of the measurement of distance from nasion to the intersection of the tangent to the superior palpebral sulci with the median sagittal plane, with the eyes open, on one hundred Hindus is 5·39 mm.

Recent Advances in Insect Embryology

Mithan Lal Roonwal has contributed an extremely useful summary of the present state of knowledge of the embryology of insects (*J. Roy. Asiatic Soc. Bengal* (*Science*), **55**, 17–105; 1938—issued 1939). The process of gastrulation, the origin of the mid-gut epithelium and, specially, the problem as to the extent to which the orthodox germ-layer theory is applicable to insects, are among those aspects of the subject that are still under dispute. Recent embryological evidence points to the conclusion that the head is seven-segmental owing to the presence of two somites—the labral and pre-antennary in front of that bearing the antennæ. Some prominence is given to the author's own idea of multiphased gastrulation and its implications. Whether this conception will ultimately find general acceptance or not is too early to predict. The carbolic acid and water technique evolved by Slifer and King is commented upon as a definite advance on the practical side of embryology, since it has made the difficult and laborious process of sectioning yolky eggs a much simpler matter. The bibliography for nearly seven hundred references accounts for practically everything that has been written on insect embryology from the earliest papers up to and including many of those published in 1938 and later. There is also a classified list under which are grouped references to works on the embryology of separate orders, on experimental embryology, on bacterial symbiosis, etc. The author's name and the year of publication are given, thus enabling the reference to be traced in the alphabetical list.

A New Anaspid Fish

Erik A:son Stensiö deals with an interesting Ostracoderm of the order Anaspida ("A New Anaspid from the Upper Devonian of Scaumenac Bay in Canada, with remark on the other Anaspids", *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien, **18**, No. 1; 1939). *Endeiolepis Aneri* n.g., n.sp. although only two specimens are available, both imperfect, throws much new light on the Anaspids in general. The head, adjacent anterior part of the trunk and certain posterior parts of the caudal fin are lacking, but enough is preserved to show very definite structure. A survey is made of the Anaspids in general and the genus Euphanerops A. S. Woodward, of which only one specimen exists, is redescribed and shown to be well distinguished from the other genera. An important and striking feature in Endeiolepis is the remains of a paired row of long, freely projecting ventro-lateral scales developed from the gill-region and reaching to the anal opening. The anterior part of this row represents the pectoral spine apparatus and the ventro-lateral scales overlap each other and form together a paired, strong ridge, covered by a fold of skin, agreeing fundamentally with the ventro-lateral scales in the Cephalaspids. The author is of the opinion that Endeiolepis "had a real paired fin-fold strengthened with ventro-lateral scales, a paired fin-fold which according to its extent must comprise homologues both of a pectoral fin, respectively pectoral spine apparatus, and a ventral fin".

Algæ from the Iranian Gulf

During 1936–37 the Danish botanist, Mag. Køie, accompanied the Danish Fishery Investigation to the Iranian Gulf, and the algal collections have been named and collated by F. Børgesen (Danish Scientific Investigations in Iran. Part 1. 1939). A small collection in the Kew Herbarium from the Persian Gulf has also been examined. Previous to this, only about half a dozen algæ had been described from the Gulf, and the present gatherings also show that the flora is very poor and in strong contrast to the rich algal flora from Dwarka on the other side of the Arabian Sea. Børgesen ascribes this to the shallow depth of only 50 m., the high temperature of the water with a mean of 24° C. and the associated high salinity; the coastal waters are not removed by any ascending currents and also the general muddy or sandy type of bottom is unsuitable for algal growth. About 6 km. south of Bushire a coral reef showed a considerable algal growth with zones ranging from high on the littoral zone, *Cladophora nitellopsis* nov. spec. as the dominant type, through an *Enteromorpha compressa* zone, a broad belt of Colpomenia and then one with *Enteromorpha clathrata* with *Ulva Lactuca*; in all these zones a number of smaller red algæ were also present. Rocks farther out supplied Sargassum spp. and an Ectocarpus. On coral reefs on the island of Kharg, corals from 1–2 m. depth had numerous small algæ attached, but many of these were sterile and so poorly developed as to be impossible to determine. A rather richer vegetation was collected from the Bahrein Islands. The algæ of this gulf are probably mainly of interest as indicating the types which are able to survive under such unfavourable conditions.

Incompatibility in Antirrhinum

IT has been known since Lotsy's work in 1911 that the peloria flower of Antirrhinum sometimes segregated in a 1 : 1 ratio in place of 3 zygomorphic : 1 radial flowers in the selfed F_2 of a cross between these forms. If, however, the F_1 plants were intercrossed, a segregation of 3 zygomorphic : 1 radial could be obtained. Brieger has shown that peloria and the incompatibility factors $S_1 - S_F$ were closely linked and therefore the 1 : 1 segregation was accounted for. He claimed that a fertility factor in *A. majus* was not allelomorphic with the *S* factors. Marta Sharman (*Z. Ind. Abst. Vererb.*, 77, 3–17; 1939), however, shows that the usual allelomorphic series of S_1, $S_2 - S_F$, where S_F is a fertility factor, will account for all the data on the inheritance of fertility and radial flowers in species crosses in Antirrhinum, and therefore Antirrhinum may be brought into line with the general rule of inheritance of self-incompatibility on East's hypothesis.

A Beneficial Pathogen

AN interesting positive value of a parasitic fungus is revealed by S. H. Ou (*Sinensia*, 9, Nos. 5–6; September 1938). The plant *Zizania latifolia* is cultivated as an aquatic crop throughout China, the hypertrophied stem-tips serving as food. The fungus *Ustilago esculenta* is invariably present in the field crop. Characteristic swollen shoot tips are not produced, however, when the fungus is killed in the rhizomes by hot water treatment at 54° C. for 15 min. Zizania therefore owes its food value to the presence of a smut fungus.

Density of Seismograph Stations

A MOST interesting table concerning the above topic has been prepared by H. Landsberg for *Earthquake Notes* (11, No. 3; Jan. 1940). It appears that for the whole earth there are 478 seismograph stations with an approximate average of one per million square kilometres of surface. Europe has 159 stations with 14 per million square kilometres; Asia 156 with 3·7 per million square kilometres; America 110 with 2·7 per million square kilometres; Australia and New Zealand 22 with 2·6 per million square kilometres; and Africa 9 with 0·3 per million square kilometres. For individual countries, Japan has the most with 127, followed by the United States, 59, and Italy, 39. Several small countries only have one. Countries with the greatest number per million square kilometres are Japan, 322·0, Switzerland, 145·3, and Italy, 125·7. England and the Channel Islands (presumably Great Britain, Ireland and the Channel Islands) are reported as having 15 stations with a density of 99·3 per million square kilometres.

Raman Spectra of Co-ordination Compounds

AN examination of the Raman spectra of 4- and 6-co-ordinated compounds of platinum (2- and 4-valent) and rhodium (3-valent) salts has been made by J. P. Mathieu (*J. Chim. Phys.*, 36, 308; 1939), supplementing previous studies with tin, zinc, iron, cobalt, nickel, palladium and iridium salts. The Raman spectra of complex compounds of metals with the same co-ordination number and analogous electronic structures show similarities; the force constant *f* increases with the atomic number. A comparison of the cyanides or nitrites of elements of neighbouring atomic numbers but different co-ordination numbers (for example, Rh and Pd, and Ir and Pt) shows that *f* has very similar values for the two metals of each pair. This establishes a parallelism between *f* and the strength of co-ordinate linking as defined by Pauling, which remains constant in all octahedral complexes on one hand and in all square complexes on the other, whatever may be the outer electronic layer of the central atom ($3d$, $4d$ or $5d$), but increases on passing from the square complex to the octahedral complex. The paper contains a detailed examination of the modes of vibration in molecular models $[M(XY)_4]$, $[M(XY)_6]$ and $[M(XY_2)_4]$ in square or octahedral structures.

Absorption within the Stellar System

AMONGST the astronomical papers presented before the Columbus meeting of the American Association in December, was one by J. Stebbins, C. Hugger and A. Whitford on the colours of early-type stars near the poles of the galaxy. Evidence already exists for a thin absorbing layer of interstellar material near the galactic plane. The absorption is most conspicuous towards the line of the Milky Way, where it produces the great rift and various dark lanes in which the stars are partially blotted out. This general absorption is accompanied by the reddening of distant stars known to be intrinsically white from the character of their spectrum lines. Conversely, from the colours of these distant white stars, an estimate can be made of the amount of absorbing dust in space along the line of sight. The colours of about two hundred white stars near the galactic poles have been determined at the Washburn and the Mount Wilson Observatories. The results have been used to measure the absorption towards the galactic poles where we look through as little of the layer as possible; in other words, a measure is obtained of the optical thickness of the layer in the vicinity of the sun. From fifty of the stars with well-determined spectra, the measured space reddening corresponds to a total photographic absorption of 10 per cent at 300 light years from the galactic plane. The detection of absorption at greater distances will depend upon the accurate determination of the spectra of fainter stars. The present result agrees with previous measures of stars at greater distances along the galactic plane, where it is found that the absorption at three thousand light years is about one stellar magnitude; that is, the stars are reduced to about two fifths of their real brightness. Beyond three thousand and up to six thousand light years towards the anti-centre of the system, there is little further effect, indicating that the dark material thins out. Toward the centre of the galaxy, however, the absorption and space reddening are greater, and there is no evidence that we can penetrate to the end of the dark material in that direction.

EDUCATION IN WORLD CITIZENSHIP

THE League of Nations Union has recently established a Council for Education in World Citizenship which held its inaugural meeting at Oxford during April 11–15. The meeting, which took the form of a National Conference of Local Education Authorities and Teachers, dealt with "Problems of Education To-day in Relation to World Settlement after the War".

Some obviously uninformed views are abroad concerning the *raison d'être* and work of the newly formed Council and it may be appropriate to say here something of the reasons that have led to its formation.

The Education Committee of the League of Nations Union was formed some twenty years ago to instruct children in the aims and activities of the League of Nations. Throughout its existence it has had official approval and has enjoyed the support of many influential and important bodies within the Empire. Junior branches of the League of Nations Union have been formed in schools throughout the country with the approval and support of the local educational authorities concerned, and it would need an article in itself to outline the other activities of the Education Committee in sending children to Geneva, in providing summer schools and camps, in arranging courses of lectures, in making contacts with the youth of other nations, in a hundred and one ways endeavouring to break down those barriers of nationalist feeling which have, alas, culminated in the tragedy which overshadows our world of to-day.

All this good work went on with apparent success for some eighteen years, despite the deterioration in international affairs which succeeded what Dr. Gooch has called the "sunshine of Locarno". But of late years certain difficulties have become increasingly apparent. The League of Nations Union is, in its very essence, a policy-forming as well as an educational body. The Education Committee is, emphatically, not a policy-forming body—its functions are educational first, last and all the time.

Nevertheless, when the League of Nations Union found itself, on occasion, acting in opposition to the policy of the Government in office, this opposition was said (quite incorrectly) to be reflected in the policy of the Union's Education Committee, which was accused of dabbling in politics.

The issue was brought to a head by the Munich crisis of 1938, when many junior branches seceded, giving as their main reason that they wished to study international affairs without necessarily subscribing to the tenets of the League of Nations Union.

It seemed therefore desirable to form a council which, while being in general sympathy with the ideals which inspire and guide the work of the League of Nations Union, should have complete autonomy in the management of its affairs.

Hence the appearance of the new Council. Its objects are to foster mutual understanding and habits of co-operation between the peoples of the different countries and to take steps to ensure that students are trained in the principles of international co-operation, including the aims and activities of the League of Nations, and the terms of its Covenant. To these ends the council will encourage and assist such teaching of school subjects as will lead to an understanding of world affairs, the growth of civilization, the chief characteristics of nations and of national governments, the factors that unite and the differences that divide nations and the responsibilities of citizenship ; will assist both students and teachers in studying the causes of war and the means whereby a more just and stable world order may be created ; will seek to provide opportunities for pupils to appreciate the best in other peoples, and to make friendly contacts with boys and girls of other nations ; will seek to ensure that nothing in our colleges and schools shall arouse hatred and contempt of other peoples ; and will teach the principles of freedom and justice, co-operation and good faith as the foundations of the good society in the home, school, State and world community.

Here, surely, is a programme with which every lover of freedom and justice will find himself wholeheartedly in agreement.

The proposed membership of the Council is wide enough to absolve it from any charge of sectarianism. It includes representatives from practically every important educational body, most of the administrative bodies connected with education, adult educational associations, committees of the British Broadcasting Corporation, the British Film Institute and representatives of the Guides and Scouts movements.

The inaugural meeting's success was qualified by only one untoward happening. Prof. Susan Stebbing was forced to cancel, by reason of illness, her paper on "Training in Clear Thinking on Public Affairs". Otherwise, the meeting's success far exceeded the anticipations of the organizers. Syllabuses are notoriously dull, but the scope of the meeting is best indicated by a résumé of the titles of the addresses heard by the three hundred delegates who attended the conference. The opening address, on "World Citizenship ; the Growth of an Idea", was delivered on Thursday evening by the chairman of the Council, Prof. Gilbert Murray. On Friday a discussion on "The League of Nations ; what next ?" was opened by Mr. Noel-Baker. On Friday afternoon Mr. H. G. Wells and Prof. Allan Ferguson opened a discussion on "The Teaching of World Unity ; what is being done and what might be done in the schools". In the evening, Prof. C. E. M. Joad delivered an address on "Proposals for Federal Union". On Saturday morning, Señor de Madariaga, M. Jan Masaryk, M. Maheu (chief representative in Great Britain of the French Ministry of Information), Count Jean Balinski Jundzill (Deputy Director of the Polish Research Centre, London), Dr. Rudolf Olden (formerly assistant editor of the *Berliner Tageblatt*), Mr. A. C. F. Beales, Mr. Ivor Montagu and Mr. W. Arnold Forster took part in a round-table discussion on "Some Guiding Principle for the next Peace Settlement". On Saturday evening Miss Dymond (Principal of the Portsmouth Municipal Training College) presented a report on "The effects of the War on the Minds of Children". On Sunday afternoon, Miss Charlesworth presided over a conference on "The Work of the Council", and on Sunday evening the delegates were addressed by the Headmaster of Rugby (Mr. P. H. B. Lyon), who took as his subject "The Spiritual Foundations of World Citizenship". The final session of the Council, to sum up the work of the Conference, was held on Monday morning, and the concluding address was given by Mr. Kenneth Lindsay, Parliamentary Secretary to the Board of Education.

Throughout the meeting the addresses and discussions attained and preserved a high level of interest. The opening address by Prof. Gilbert Murray, with its insistence on the futility of any form of political or economic co-operation which is not backed by a real will to brotherhood—by an intellectual co-operation having a firm ethical basis—marked a line of thought which dominated the subsequent proceedings of the conference and which emphasized at once the difficulties and hopes attending any advance towards world unity.

So, too, the Headmaster of Rugby in his Sunday evening address. Therein he deplored the tendency of modern teaching to over-emphasize the ethical, and to lay too little stress on the religious outlook. In internationalism shorn of the religious habit of mind there was little driving force, and "as sentiments grew wider they grew shallower". He urged that religious education should be regarded as a fundamental necessity.

Mr. Noel Baker's address was an eloquent plea for a strengthening of the terms of the Covenant of the League. The League had not failed, in any true sense of the word. It had many successes to its credit, and, where its machinery had apparently broken down, the reason was to be found in the fact that commitments had been undertaken, had not been repudiated, but had remained unfulfilled. The address provoked a lively discussion.

In the afternoon's session on the teaching of world unity, Mr. H. G. Wells was as stimulating and provocative as ever. The present state of affairs in the teaching world (in particular the meagreness of the resources which the teacher had at hand in the matter of encyclopædias, books and apparatus) came in for some vigorous criticism. World unity was a fact; war was civil war; the non-combatant had disappeared, and the neutral was fast disappearing; League and Federal notions might well lead to failure, in the latter case because federated *blocs* might result, leading to war on a larger scale. It should not, however, be impossible to bring into one world opposition the oppositions which existed in the governments of all civilized countries, and so to persuade sovereign States to relinquish the control of matters which otherwise they would not relinquish. From the point of view of the teacher, old-fashioned history should be replaced by the study of the science of human ecology, the relation of man to his external surroundings—children should be taught, not by telling them little stories of kings and queens, but by showing them their relation to the world as a whole.

Prof. Ferguson pointed out that science teaching provided an ideal medium for fostering the international outlook, and for exhibiting some of the most important relations of the individual to the community of which he formed a part. They had heard much of the effect of the aeroplane and of other inventions and discoveries in annihilating distance, but there were other and hitherto rather neglected topics about which equally fascinating stories could be told. He instanced some of the details concerning the transport and storage of food, and the new and rapidly growing industry of plastics. As regarded the teaching of history, a little investigation had shown that many teachers in training colleges and in public and secondary schools were fully alive to the necessity for teaching the subject from the point of view of world history, and that experiments in the improvement of international understanding by way of camps, tours abroad, junior branches of the L.N.U., and exchanges of visits and of letters were by no means unknown. In the primary schools, too, the teaching of history had changed remarkably in recent years. Any widening of outlook must be based on accurate knowledge oriented by an emotional appeal.

Undoubtedly, high though its general level had been, the culminating point of the Conference was reached in Saturday morning's round table discussion, and the varied views and high qualities of statesmanship shown therein made a deep impression on the delegates. The prevailing impression left on the minds of many hearers was that, although some approaches to world unity may, on paper, seem preferable to others, yet, granted good will, almost any scheme would work; that the gravest task which faces the statesmen burdened with the responsibility of realizing any future proposals for peace is that of ensuring that the proposals shall be carried out in a spirit of mutual helpfulness; that hatred shall be reserved for the sin, rather than for the sinner; and, to that end, that the peace proposals shall be worked out in detail after an armistice period which might extend over a period of some years. The Polish speaker, in the course of a moving speech, suggested that in addition to the closer union of Britain and France which might be regarded as initiating a new world order, a similar union might be contemplated between Poland and Czechoslovakia.

Mr. Arnold Forster, who summed up the discussion, was not in favour of a long armistice, and suggested that four stages should be contemplated in the making of peace—a period of conversation, an armistice, a period for the drafting of the peace treaty, and, finally, a world conference at which the terms of a general settlement should be discussed.

Saturday evening's meeting, to which Miss Dymond presented a report on "The Effects of the War on the Minds of Children", evoked very general interest. The number of pupils who were the subject of experiment was 317, and all were in the 12-year age-group. Pupils were asked to write (without preparation) a half-hour essay on 'Why we are at war with Germany'. There was a majority (62 per cent of the boys and 60 per cent of the girls) who stated clearly that the war was due to German aggression.

Asked, "Who is your favourite hero ?", the members of the group showed surprisingly little interest in the outstanding figures of the day. Mr. Chamberlain scored four votes, Mr. Churchill three. Most of the boys voted for Nelson and Drake.

There were few reactions to war-professions in the answers to the question, "What would you like to be when you grow up ?—none at all among the girls, unless a desire to take up nursing be correlated with the War.

Perhaps the most interesting and illuminating answers were those given to the question, "What was the most important day of your life ?" Some

11 per cent of the boys and 12 per cent of the girls who had been evacuated mentioned the day of evacuation or that of the outbreak of war. On the other hand, a very large number voted for the day on which they sat for the junior scholarship examination.

Asked to continue a story which began, "There was a loud bang, Pat's heart beat fast," the boys tended towards adventure stories not necessarily connected with the War, girls to air-raid stories.

To the question, "In what period of history would you have preferred to live ?", the majority answered "The present time", and the surprising reason given was, "Because it's more comfortable." A significant number of girls chose a period in which they could wear a picturesque dress.

A free-association test, in which the significant words were "bang, ship, enemy aeroplane, shell", showed a strong war connexion with 'enemy' and 'bang', and it is interesting to note that 'shell' often evoked associations with the sea-shore.

Generally, the investigation showed that the War has had a considerable but not an overwhelming effect on the minds of children.

The impression which the conference as a whole has left on the mind of the writer of this review of its work is that the future of any successful approach to world unity lies in the hands of the teachers, and primarily in the hands of those responsible for the training of our youth below the age of fourteen; that we must rid ourselves of the delusion that there is a ladder of education with the primary school on the lowest rung, and the university on the topmost, and must realize that by far the most important years of education are those passed in our primary and senior schools, and that what happens in later stages is a divergence, rather than a climb; that there is an urgent need for the raising of the status and for the broadening of the training of those destined to become teachers in elementary schools; that the education of such teachers should not be regarded as ending with their period of training, but that every encouragement should be given to their making contacts with the world of thought which lies outside their school; that it is a desirable thing to teach school subjects from a point of view wider than that of mere nationalism, but that such knowledge must be exact, and must, moreover, be informed by spiritual forces supplied, indirectly, in the home as well as in the school; forces, too, which the teacher must experience in his own home and college ere he can make their influence felt by those whom he is later called upon to teach; that the council is fully alive to these considerations; and that the council will be on the high road to success if its subsequent deliberations are informed with as much knowledge backed with as high an enthusiasm as was shown at its inaugural meeting.

ESKIMO OF LABRADOR*

In the course of the Rawson-MacMillan Subarctic Expedition of the Field Museum (1927–28), Dr. W. Duncan Strong secured a large series of measurements and observations of living Labrador Eskimo and a small group of Montagnais-Naskapi Indians. When obvious mixed bloods and sub-adults are eliminated, the numbers were 137 Eskimo (58 males, 79 females) and 18 Indians (11 males, 7 females). Labrador Eskimo skeletons were also obtained, including thirty-two measurable skulls (17 males, 15 females), many with associated skeletal parts. Measurements made by Shapiro, Boas, Pittard, Duckworth and others have been added in this study. An unusual series is thus made available, comprising (1) an old stone grave series, pre-white, and earlier than 1770; (2) a mid-nineteenth century grave series (early Mission period); and (3) recent living (1880–1928).

The material is drawn from the Eskimo of the north-east coast of Labrador, a remnant of a population once extending to the Gulf of the St. Lawrence. While the influence of the Moravian Mission has been directed to the preservation of Eskimo culture and habits, adoption of Caucasian types of food appears to have introduced modifications of physique, especially in reduction of stature and in general bodily habit of fat.

In the investigation of the Eskimo of Labrador, the evidence of physical character must be invoked to aid in the elucidation of the archæological question. Briefly and in very general terms, the archæological problem is to determine the relation in the cultural sequence of pre-Thule, the Dorset and Thule cultures, and recent Eskimo. The evidence of physical anthropology is subject to very definite limitations, not least owing to the absence of skeletal material to be assigned to the Dorset culture.

It would appear that the culture of the Labrador Eskimo was most closely related to that distributed over the central Arctic, but retained more of the Thule culture than has survived in the central regions proper (T. Mathiassen). The Thule culture in the eastern Arctic is present only on pre-contact sites, except for a group on Southampton Island. Although Thule is considered to be the original Eskimo culture of the eastern Arctic, evidence has been presented suggesting that Thule may have been preceded by the Dorset people, though possibly in some places contemporaneous (D. Jenness).

In north-eastern Labrador evidence has been found of an earlier stone culture with Eskimo-like stone *ulus*, ground slate points and chipped scrapers. It contains almost nothing of the bone, antler, ivory and steatite artefacts characteristic of Thule, Dorset, and Labrador Eskimo (W. D. Strong); and this leads to the suggestion that the Eskimo cannot have been in Labrador for more than four hundred years.

By fitting ethnological detail into this succession of eastern Arctic cultures extending back into the prehistoric, several theories of Eskimo origin and migrations have been formulated, in which the crucial difference is the position to be assigned to the Caribou Eskimo of the interior, west of Hudson Bay. These people, in the view of K. Birkett-Smith, are a relatively unchanged remnant of the population from which all other Eskimo arose, while Matthiassen regards Thule as the original Eskimo culture and the first to spread eastward over the Arctic coast of America. D. Jenness, on the other hand, has recently put forward the suggestion of a triple division of the present-day Eskimo of Canada in which the natives of the Mackenzie River delta descend from old Thule people who migrated from Alaska to the eastern Arctic a thousand or more years ago, dropping colonies on the way; a second division on the Barren Grounds behind the Hudson, the inland Eskimo, survivors of the primitive Caribou; and descendants of the Eskimo who, about A.D. 1200, flowed out of the inland 'reservoir' and occupied the whole coast-line from Coronation Gulf to Labrador, overwhelming the earlier coast dwellers.

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* Anthropometric Observations on the Eskimos and Indians of Labrador. By T. Dale Stewart. Material and Data collected by William Duncan Strong. (Anthropological Series, Vol. 31, No. 1) (Publication 462). Pp. 164+16 plates. (Chicago: Field Museum of Natural History, 1939.) 1·75 dollars.

On the grounds of cultural succession, it seems best to assume two reservoirs of population at the beginning of the Christian era, one in Alaska and one in the central Arctic, which must once have been united, presumably before the development of the earliest known culture in the west, the old Bering Sea culture.

Hence it follows that for interpretation of the Labrador physical type comparison with (*a*) the "Old Igloo" (Birnirk) type from Point Barrow, the oldest known, which has been identified by Hrdlička; (*b*) the Thule; and (*c*) the Dorset physical types is an essential. Unfortunately, as already mentioned, the Dorset type is unknown, while the Thule type was identified only recently (Fischer-Möller, 1937).

The indications of comparative study of the measurements as a whole are that the Labrador skull is small. Metrically, Greenland bears the closest resemblance to Labrador. The main physical changes indicated in a comparison of the old stone grave material and that of the recent grave series is that, as compared with the pagans, the Christians have smaller and shorter heads with longer and narrower faces, relatively higher orbits and relatively narrower alveolar arches. It is uncertain whether the nose has changed. Stature reconstructed from the measurement of the long bones is as follows: old stone graves, 161·4 (male), 150·3 (female); recent graves, 161·2 (male), 149·8 (female). This suggests that Eskimo stature has decreased in Labrador since the eighteenth century, a conclusion borne out by the findings on the living. Two stature groups can be distinguished: (1) a low-statured group averaging in the males about 160–162 cm., found chiefly in the east (Labrador, southern Greenland), and (2) a high-statured group, 164–166 cm., in the males, found chiefly in the west, but also among the Thule people in the east.

To sum up, it may be said that these data on the prehistoric Labrador Eskimo establish more firmly the fact that the physical type represented is much the same as that predominant in Greenland; it differs materially from that of the western longheads (Old Ingloo). Also it contrasts with that of the Thule. Assuming that Labrador was populated originally by Thule people, the type did not survive. Whether the Labrador and Greenland type was derived from a mixture of the Thule and Dorset peoples, or a representative of the latter alone, cannot be decided until the Dorset type is identified.

SEVENTY YEARS AGO

NATURE, vol. 1, April 28, 1870

Early Torpedoes

THE first of a series of articles on "The Science of Explosives as applied to Warlike Purposes" appears, and deals particularly with history of the use of explosives as floating or submarine mines and torpedoes.

The earliest form of marine mine appears to have been the 'explosion ship' used by the Dutch to destroy a boom or boat-bridge constructed across the Scheldt in 1585. Several flat-bottomed vessels loaded with gunpowder were sent against the boom, exploding when they reached it. A development of this was the 'floating petard' used by the English during operations in Rochelle in 1628; this consisted of a sheet-iron case filled with powder which was exploded by a match-lock mechanism set off by contact with an obstacle.

An American, Robert Fulton, seems to have been the first to use the term 'torpedo'. His device consisted of a metal vessel holding about 100 lb. of gunpowder and fitted with clockwork to release a flint-lock at a determined time. The machine was partly encased in cork so that it was a little heavier than water, and was attached by a line to a box float. The torpedoes were carried in harpoon boats, and connected by long lines with harpoons fired from small guns at the ship to be attacked. If the harpoon was successfully planted, the torpedo was drawn into the water by the line, the clockwork firing mechanism released, and the torpedo exploded by the time it had drifted near the vessel attacked. Demonstrations with these torpedoes were carried out before English naval authorities in 1805. A diagram of a torpedo and its harpoon is printed.

Extensive use was made of mines, or torpedoes as they were called, in the American Civil War, both mechanical and electrical means of ignition being used.

Legislation and Nature

"THE effect of Legislation upon Nature is one of those far-reaching subjects which men are only just beginning to investigate in a practical spirit. . . . Neither directly nor indirectly, in fact, can we touch Nature by our laws, without beginning a new chain of causes, the end of which we cannot foresee."

Mr. E. Goadby is discussing an item in the Budget introduced by Mr. Lowe. "The freedom of firearms from taxation affects their number in any district, the number of guns determines the number of small birds, and the number of our small birds affects the immunity of our fields from grasshoppers, cricket-moles, beetles, locusts, slugs, etc. Mr. Lowe was concerned for the security of life, for the prevention of early quasi-poaching habits, but his 1 *l.* tax may effect a revolution all the same."

Another topic also discussed by Mr. Goadby is the rating of woods and plantations. He refers to the incidence of insects in relation to trees, and concludes: "Disafforesting threatens to become as common in the nineteenth as enclosuring was in the sixteenth century. Are we wise to hasten it?"

THIS issue of NATURE completes the first volume of twenty-six weekly issues, price 4*d.* each. The volume includes 558 pages of text and 110 pages of advertisements.

FORTHCOMING EVENTS

[Meeting marked with an asterisk is open to the public.]

Monday, April 29

PHYSICAL SOCIETY, jointly with the CAMBRIDGE PHILOSOPHICAL SOCIETY (in the Cavendish Laboratory, Cambridge), at 3 p.m.—Discussion on "The Liquid State" (to be opened by Prof. J. E. Lennard-Jones, F.R.S.; other speakers: Prof. E. N. da C. Andrade, F.R.S., Prof. Allan Ferguson, J. Corner, Prof. J. D. Bernal, F.R.S., Prof. W. L. Bragg, F.R.S., Prof. R. H. Fowler, F.R.S., Prof. N. F. Mott, F.R.S.

Tuesday, April 30

ROYAL INSTITUTION, at 5.15 p.m.—Major-General Sir Robert McCarrison: "The Medical Aspects of the Use of Food".*

INSTITUTE OF PHYSICS (in the Lecture Hall, Kodak, Ltd., Harrow), at 7.30 p.m.—Prof. N. F. Mott, F.R.S.: "Oxidation of Metals and the Theory of Protective Films".

Thursday, May 2

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4 p.m.—Prof. R. J. S. McDowall: "The Circulation in Relation to Shock".

Friday, May 3

PHYSICAL SOCIETY (in the Physics Department of the Imperial College of Science), at 5.15 p.m.—Discussion on "The Teaching of the Fundamentals of Electric and Magnetic Theory" (opening paper by Dr. G. B. Brown).

ROYAL INSTITUTION, at 9 p.m.—Prof. W. L. Bragg, F.R.S.: "The Symmetry of Patterns".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEMPORARY ASSISTANT LECTURER IN AGRICULTURE at the Essex Institute of Agriculture, Writtle—The Clerk to the Essex County Council, County Hall, Chelmsford (April 30).

TEMPORARY FULL-TIME LECTURER IN PHYSICS—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15 (May 6).

DIRECTOR OF RESEARCH to the Institution of Automobile Engineers—The Chairman, Automobile Research Committee, 12 Hobart Place, S.W.1 (May 6).

SENIOR LECTURER IN CIVIL ENGINEERING at the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (May 15).

SCIENTIFIC ASSISTANT IN THE WATER EXAMINATION DEPARTMENT—The Clerk to the Metropolitan Water Board, New River Head, 173 Rosebery Avenue, E.C.1 (quoting 'Scientific Assistant') (May 24).

TEMPORARY ASSISTANT CIVIL ENGINEER—The Borough Engineer, Town Hall, Eastbourne.

ASSISTANT ENGINEER for the Drainage and Irrigation Department, Malaya—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9114).

ENGINEER TRANSPORT OFFICER by the Government of the Gold Coast—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9320).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Air Force for the Peace Front. A Plan prepared by the Military Research Committee of the New Commonwealth Institute. (Published for the New Commonwealth.) Pp. 39. (London: The Peace Book Co.) 6*d*. net. [24

Report of the Rugby School Natural History Society for the Year 1939. (Seventy-third Issue.) Pp. 67. (Rugby: George Over, Ltd.) [44

Other Countries

U.S. Department of the Interior: Geological Survey. Professional Paper 189-G: Foraminifera, Diatoms and Mollusks from Test Wells near Elizabeth City, North Carolina. By L. G. Henbest, K. E. Lehman and W. C. Mansfield. (Shorter Contributions to General Geology, 1937.) Pp. ii+217-228. 10 cents. Professional Paper 189-I: Fossil Plants from the Colgate Member of the Fox Hills Sandstone and adjacent Strata. By Roland W. Brown. (Shorter Contributions to General Geology, 1937.) Pp. ii+239-276+plates 47-63. 15 cents. Professional Paper 192: Areal Geology of Alaska. By Philip S. Smith. Pp. iv+100+18 plates. 1.25 dollars. (Washington, D.C.: Government Printing Office.) [293

U.S. Department of the Interior: Geological Survey. Bulletin 906-A: Gravel and Sand Deposits of Eastern Maryland adjacent to Washington and Baltimore. By N. H. Darton. (Contributions to Economic Geology, 1938-39.) Pp. v+42+10 plates. 1.25 dollars. Bulletin 906-B: Geology and Coal Resources of the Minot Region, North Dakota. By David A. Andrews. (Contributions to Economic Geology, 1938-39.) Pp. iv+43+84+plates 11-15. 50 cents. Bulletin 909-D: Geophysical Abstracts 95, October-December 1938. Compiled by W. Ayvazoglou. Pp. ii+151-222. 15 cents. Bulletin 916-A: Transit Transverse in Missouri. Part 1: Southeastern Missouri, 1903-37. Pp. x+124+xi-xiv. 20 cents. Bulletin 917-A: Mineral Industry of Alaska in 1938. By Philip S. Smith. (Mineral Resources of Alaska, 1938.) Pp. ii+113+1 plate. 35 cents. (Washington, D.C.: Government Printing Office.) [293

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 836-C: Artesian-Water Levels and Interference between Artesian Wells in the vicinity of Lehi, Utah. By G. H. Taylor and H. E. Thomas. (Contributions to the Hydrology of the United States, 1938.) Pp. iii+107-156+plates 12-14. 15 cents. Water-Supply Paper 836-D: Ground Water in the United States; a Summary of Ground-Water Conditions and Resources, Utilization of Water from Wells and Springs, Methods of Scientific Investigation, and Literature relating to the Subject. By Oscar Edward Meinzer. (Contributions to the Hydrology of the United States, 1938-39.) Pp. v+157-232+plate 15. 15 cents. (Washington, D.C.: Government Printing Office.) [293

Smithsonian Miscellaneous Collections. Vol. 91, No. 30: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Cornucopina (Bryozoa) from the West Indies. By Raymond C. Osburn. (Publication 3584.) Pp. ii+4+2 plates. Vol. 91, No. 31: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Genus and Species of Eel from the Puerto Rican Deep. By Earl D. Reid. (Publication 3585.) Pp. ii+6. Vol. 99, No. 3: Ritual Ablation of Front Teeth in Siberia and America. By Aleš Hrdlička. (Publication 3583.) Pp. ii+32+5 plates. (Washington, D.C.: Smithsonian Institution.) [14

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 2: Parent-Education Programs in City School Systems. (Being Chapter IX of Vol. 1 of the Biennial Survey of Education in the United States, 1934-36.) Pp. v+35. 10 cents. Bulletin, 1939, No. 7: Individual Guidance in a CCC Camp; its Effect upon Participation and Quality of Work in a Voluntary Educational Program. Pp. vii+43. 10 cents. (Washington, D.C.: Government Printing Office.) [14

Field Museum of Natural History. Anthropological Series, Vol. 25, No. 3: Craniometry of New Guinea. By Wilfrid D. Hambly. (Publication 465.) Pp. 81-290+plates 31-74. (Chicago: Field Museum of Natural History.) 2.50 dollars. [14

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 857: Surface Water Supply of the United States, 1938. Part 7: Lower Mississippi River Basin. Pp. v+197+1 plate. 25 cents. Water-Supply Paper 860: Surface Water Supply of the United States, 1938. Part 10: The Great Basin. Pp. iv+103+1 plate. 20 cents. Water-Supply Paper 863: Surface Water Supply of the United States, 1938. Part 12: Snake River Basin. Pp. vi+238+1 plate. 30 cents. (Washington, D.C.: Government Printing Office.) [24

Palaeontologia Sinica. New Series D, No. 6 (Whole Series No. 117): Bone and Antler Industry of the Choukoutien *Sinanthropus* Site. By Prof. Henri Breuil. English translation by Miss M. E. Boyle. Pp. viii+40+26 plates. New Series D, No. 9 (Whole Series No. 120): The Upper Cave Industry of Choukoutien. By Pei Wen Chung. Pp. 41+8 plates. (Peiping: Geological Survey of China.) [34

Connecticut Agricultural Experiment Station. Bulletin 417: Commercial Fertilizers Report for 1938. By E. M. Bailey. Pp. 56+viii. Bulletin 418: The European Red Mite and its Control. By Philip Garman and J. F. Townsend. Pp. 34. Bulletin 419: Hibernation of the Corn Ear Worm in Southern Connecticut. By G. W. Barber. Pp. 28. Bulletin 420: The Native Elm Bark Beetle *Hylurgopinus rufipes* (Eichhoff) in Connecticut. By B. J. Kaston. Pp. 40. Bulletin 421: Annual Report for the Year ending October 31, 1938. Pp. 68. Bulletin 422: Tobacco Sub-station at Windsor—Report for 1938. By P. J. Anderson, T. R. Swanback and O. E. Street. Pp. 50. Bulletin 423: The Soil Characteristics of Connecticut Land Types. By M. F. Morgan. Pp. 64+35 maps. Bulletin 424: Chemical Investigations of the Rhubarb Plant. By Hubert Bradford Vickery, George W. Pucher, Alfred J. Wakeman and Charles S. Leavenworth. Pp. 158. Bulletin 425: Commercial Feeding Stuffs—Report on Inspection, 1938. By E. M. Bailey. Pp. 100. Bulletin 426: The Forty-third Report on Food Products, and the Thirty-first Report on Drug Products, 1938. By E. M. Bailey. Pp. 56. Bulletin 427: Volume Tables, Plantation Grown White Pine, *Pinus strobus* L., in Connecticut. By Henry W. Hicock, Arnold D. Rhodes and A. Richard Olson. Pp. 14. Bulletin 428: Connecticut State Entomologist—Thirty-eighth Report, 1938. By Dr. W. E. Britton. Pp. 122. Bulletin 429: Seasonal Water and Nitrate Leachings in relation to Soil and Source of Fertilizer Nitrogen (A Second Report on Windsor Lysimeter Series 'A'). By M. F. Morgan and O. E. Street. Pp. 44. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [34

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A MINISTRY OF RECONSTRUCTION

THE measures advocated by Sir Gwilym Gibbon in a recent issue of *Public Administration* for the co-ordination of departments into groups with a minister for each, the Cabinet consisting of the Prime Minister and these ministers-in-chief and a few other ministers with few or no departmental duties, recall the report of the Machinery of Government Committee, of which Lord Haldane was chairman. Little or nothing has been done to implement the findings of that report since it appeared so long ago as 1918; but Sir Gwilym, in urging that it is imperative that this Cabinet directorate "shall be relieved of all but the matters of most importance, and that above all, it and its members shall have enough freedom from pressing duties to think of coming problems (as well as of current) well ahead of their coming", is indeed only restating the arguments and views of that report.

Lord Haldane's responsibility for the drafting of the Committee's report is well known, and its major recommendation, that every Department of State should be provided with its general staff and that a Ministry of Information and Research should be created for this purpose, was reflected in his presidential address to the Institute of Public Administration in 1922. Under the title "An Organized Civil Service", he appealed not merely for efficient and scientific administration and for the high tradition of self-sacrifice for public duty, but also for the forward-looking mind.

Lord Haldane did not conceal his doubts whether this outlook was being sufficiently encouraged in the Civil Service of Great Britain or in the universities from which its administrative officers are largely recruited, just as on another occasion he questioned the capacity of the older universities to train men of the requisite precise habit of mind. It is no reflection on the valuable work which in the last twenty years has been carried out by the Institute of Public Administration and elsewhere to suggest that we have no reason to be any more satisfied with the present state of affairs. In the organization of civil defence in the last few years, and also in the measures taken in the economic crisis of 1931, there has been all too little evidence of the forward-looking mind and appreciation of the importance of scientific management or a scientific outlook.

Better provision for inquiry, research and reflection before policy is defined and put into operation could undoubtedly have avoided some of the worst mistakes in evacuation and other operations. If, however, such mistakes can be overlooked, once they have been admitted and rectified, their repetition becomes intolerable, whether from the point of view of war effort or of the reconstruction to follow the War. It is this position which gives fresh pertinence to the report of the Machinery of Government Committee, the more particularly as some of the reconstruction proposals which were implemented after the War of 1914–18 were liquidated in the aftermath of the crisis of 1931.

In the first place, it will be noted that the Machinery of Government Committee was established under the Ministry of Reconstruction, and is itself an example of the organized thinking which was carried out in the last two years of the 1914–18 war period. A valuable feature of a recent broadsheet issued by P E P (Political and Economic Planning) on Reconstruction, 1916–1919, is the reminder it gives of the many reforms in law, in local government, in power supply and other fields, which we owe to men who during those harassing years and in such unfavourable circumstances proved themselves competent, not merely to organize victory, but also to think ahead boldly and with a precision justified by results when their proposals have been put to the test of practice.

The most cursory survey of the work of the Ministry of Reconstruction established in July 1917 and of the outcome of its activities will testify to the value of such work even in time of war, when victory is far from being in sight, and, indeed, of its essential importance if we are to realize the new world order which we look for after the present struggle. Unless the main underlying trends are analysed now and directed to constructive purpose in the light of possibilities and limitations which must persist whatever the outcome of the War, we may be once again in danger of losing the peace when we have won the war.

The Ministry of Reconstruction itself was liquidated in 1919, but in the Forestry Commission, the Electricity Commission, the Central Electricity Board, to mention only three public bodies, we are still able to benefit from the outcome of its deliberations. The grouping of the main-line railways, the reorganization of local government in 1930, and the Law of Property Act, 1925, were further results, and the work of the Whitley Committee on labour relations is another outstanding achievement, which has now provided a firm framework for industrial relations in Great Britain.

Besides its own particular activities, the Ministry of Reconstruction aimed at co-ordination as well as planning, and whether in dealing with the problems immediately following the cessation of hostilities—demobilization of man power, decontrol of raw materials and productive capacity, and generally setting the wheels of trade and commerce going again—or in those of the succeeding period of settled peace, it made contributions for which we owe a great debt to Lord Addison and his colleagues. During those years the country was equipped for the first time with a department devoted to research into questions of political science and to the encouragement of action on the lines ascertained.

The subsequent twenty years, however, afford no grounds for easy optimism concerning the extent to which the primary importance in reconstruction of organized thought, as distinct from executive action, is more widely recognized. Certain of the organizations brought into being by the Ministry of Reconstruction have already been discarded—for example, the Economic Advisory Council, which in 1930 was formed out of the Committee of Civil Research, itself a child of the Machinery of Government Committee. Moreover, in this very field, refusal to make full provision for co-ordinating economic policy is at least causing profound uneasiness in many minds. So, too, as a valuable article in the *Political Quarterly* by Dr. W. A. Robson shows, is the neglect to deal with such long-term problems as the location of industry, although the Barlow Commission has already reported.

These indications of *laissez-faire* mentality are profoundly disturbing. We cannot assume that refusal to face long-term problems involves the more vigorous and efficient handling of short-term problems. There is plenty of evidence of timid and unintelligent treatment of important short-term issues. Indeed, as Dr. Robson points out, the abandonment of the reports of the Royal Commission on the geographical distribution of the industrial population of Great Britain deals a fatal blow at the development of a scientific treatment of the problems of evacuation. Unless even greater mistakes are to be avoided, some attempt must be made at central control. Town and country planning have acquired a new and more important status. They should, as Dr. Robson urges, be placed in the hands of a strong central department, competent not only to deal with the special needs of the Service departments and the Government offices, but also to take over the task of directing the location of industry and formulating a national plan for the whole country.

The experience of the Ministry of Reconstruction affords evidence of what is possible and indeed essential even in the stress of war, and its achievements will well repay study at this time. All the experience of the last twenty years, however, reinforces the plea for planning ahead. The task cannot and should not be avoided in war-time. It is in no way an impediment to victory. On the contrary, so many of our war-time exigencies are entirely consistent with socially desirable peace-time purposes that the same planning ahead which best serves our immediate war-time purpose will contribute most to subsequent reconstruction. The many factors which in the last two decades have intensified the need for bringing to bear organized thinking and the acquisition of facts as a basis for action into the affairs of State, emphasize the need for adequate attention now to the problems of reconstruction

MR. FISHER'S VARIOUS ESSAYS

Pages from the Past
By H. A. L. Fisher. Pp. viii+238. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 10*s.* net.

THIS delightful book may easily become the most popular of Mr. Fisher's writings. It is wholesome medicine for the times in which we live because it takes our minds away from them. The longest essay is one dealing with the "Whig Historians", and, of course, for the most part defending them. Macaulay, Mackintosh and Sir George Trevelyan are the most prominent figures in it, and Macaulay never found a more stalwart—yet withal a discriminating—admirer. The cleverest paper is a sketch of what might have happened had Napoleon made his escape to North America and afterwards attempted the setting up of a new empire in the New World, which was at that time disturbed by many revolutions, centring round the figure—rather more heroic than Mr. Fisher presents him—of Simon Bolivar. There are charming pictures of the "Beauty of England", and a very curious account of a New College 'progress' when the Warden, accompanied by his junior outrider, used to drive round visiting all the neighbouring College farms, taking the homage of the respectful tenants and being solemnly entertained by the dependent folk of the holding. It is to be feared that this picturesque custom has now fallen into disuse, and we are the more obliged to Mr. Fisher for putting it on record. He says quite truly that the public—even the College public—are not aware of the extent of the agricultural interests of the colleges of Oxford and Cambridge. In our days the picturesqueness has been worn off by the motor-car, but science has come in to improve the agricultural methods by which the bursars guide the operations of the college tenants.

There is another essay in the volume which has a rather surprising title and will appeal especially to readers of this review. It is called "The Real Oxford Movement" and deals with the group of men who in the middle of the seventeenth century happened to come together in Oxford and formed the nucleus of what was afterwards removed to London and became the Royal Society. Mr. Fisher calls it the Real Oxford Movement, but he admits the existence of many others and would be the first to allow that other places, especially London and Cambridge, have a claim to preeminence in science. The latter will always stand first on the roll with the names of Newton and Darwin, and it was in the former that this "invisible college" first met which was transferred to Oxford during the years of 1648–1659.

The movement began with a small group of doctors and other earnest inquirers who sought the quiet of Oxford during the tumult of the Civil War, and it found in Oxford members of the University who had already begun "a free way of reasoning" of their own. It is these men whom Mr. Fisher describes so vividly and who were later to form the nucleus of the Royal Society, when it came into permanent public and authorized notice. They seem to have met mostly in Wadham, of which Wilkins, one of their members, was warden during 1648–59. He was primarily an astronomer, son of an Oxford goldsmith and with clever hands as well as mechanical tastes. He was a "most obliging and universally curious Dr.", who afterwards became bishop of Chester and the first secretary of the Royal Society.

But there were other men of greater originality who left more notable evidence of their scientific powers. William Petty was one of these. By turns cabin-boy, hawker and seaman he came back to England in 1646 after having become a physician by studies abroad. He ranks as an English classic by virtue of his "Essays on Political Arithmetic", which were the first attempt to apply to political problems the notions of number, quantity and measurement. He was an ancestor of Lord Lansdowne and would rank as the most brilliant of the group, had it not been for Christopher Wren, whose accomplishments entitle him to be considered the most versatile and famous of the group.

A great geometer and astronomer and anatomist, Wren added many buildings to medieval Oxford before he gave London its most conspicuous church after the Great Fire of 1665. He was at that time Savilian professor of astronomy at Oxford. When we add to these names that of John Evelyn who visited Oxford in 1654 when the group was in full activity, Robert Boyle who went to Oxford in 1654, and Robert Hooke who competed with Wren for the design of St. Paul's, one may wonder whether so brilliant a group of young men ever adorned English science at the same time before. They were all at Oxford about the same time at some period of their career and they well justify Mr. Fisher's title of the "Real Oxford Movement". It is a strange catastrophe in English history that so bright a growth should have died away into the apathy and ignorance which are described in the Oxford of Adam Smith and Gibbon in the next century.

There are several other essays, largely biographical, for example, Lord Balfour, John Morley, Philip Snowden and politicians in general, which make up a fascinating volume. Mr. Fisher was, of course, uniquely qualified to bring together recollections of Oxford, history and politicians, and it is done here with a special charm.

F. S. MARVIN.

PREHISTORY OF JERSEY

The Archæology of the Channel Islands
Vol. 2: The Bailiwick of Jersey. By Jacquetta Hawkes. Pp. xvii+320+12 plates. (Jersey: Société Jersiaise, 1939.) 25*s.* net.

THIS survey of the archæology of the Channel Islands was projected by Mr. T. D. Kendrick, by whom the first volume, dealing with the Bailiwick of Guernsey, was published in 1928. Other interests supervened, and in 1934 Mr. Kendrick passed his material relating to Jersey—field notes, and analyses of manuscript and published sources—to Mrs. Hawkes. This material she has re-interpreted and expanded in the light of the revolutionary ideas and discoveries which have supervened in European archæology since the first volume appeared, and now publishes as a review of the prehistory of the Bailiwick of Jersey.

The relics of the remoter past of the Channel Islands have long attracted the interest of antiquarians; while the island of Jersey earned no little notoriety of a less enviable kind in the annals of archæology by the mistaken, if grateful, act of generosity of the States of the Island when, in the early years of the nineteenth century, they made the embarrassing gift of one of their finest megalithic monuments to General Conway, the Lieutenant-Governor of the Island, by whom it was re-erected complete on his estate at Henley.

No little interest, of a more honorific character, has been aroused by these megalithic monuments, of which the Channel Islands present an astonishing assemblage, in view of the small size of the islands—Jersey, 44 square miles, and Guernsey, 24½ square miles only—while Guernsey can show two remarkable examples of the anthropomorphic sculptured menhirs characteristic of the cult of the Mediterranean goddess. This interest, however, was eclipsed by the discovery in 1910 of the teeth of Neanderthal man, associated with relics of a pleistocene fauna—mammoth, woolly rhinoceros, elk, horse and several deer—in the cave of La Cotte de St. Brelade then under excavation, but from the deposits of which Mousterian implements had been extracted so long before as the nineties of the preceding century.

Since the War of 1914–18, Jersey has not been passed by in the enhanced interest attaching to archæological investigation in the field; and the enthusiasm of the members of the Société Jersiaise, the local scientific society, has added much to knowledge of the facts of the island's prehistory, some of which is of wider than local bearing, as Mrs. Hawkes points out: notably Dr. A. Mourant's investigation of peat deposits and the quaternary geology of the island, the examination of the mound of La Hougue Bie, or Prince's Tower as it is known in local legend and popular parlance, which the Society purchased in the interests of scientific research, and the remarkable habitation site of Le Pinnacle, excavated by Father Christian Burdo and Major A. D. B. Godfroy in 1930–35, important for its contribution to stratigraphic evidence of a positive and negative bearing on the archæological story of the island, of which Mrs. Hawkes makes use with convincing effect.

The archæology of Jersey differs from that of the islands of Guernsey and Alderney in certain respects, of which some are of paramount importance to archæological interpretation, as Mrs. Hawkes demonstrates. In the first place, Jersey is the only one of these islands in which palæolithic man appears. Nor is Neanderthal man of the caves, with his Mousterian implements of the Middle Palæolithic, the earliest of his compatriots to which the Jerseyman can point. Four palæolithic flint implements, unfortunately of unknown origin, have been found on the beaches of the island, of which two are undoubtedly Acheulean. Why palæolithic man with his associated fauna should appear in Jersey and not in Guernsey, distant only 18 miles away, is explicable only on the inference from the evidence of a fauna which could not be maintained on a small island and the depth of intervening channels, that whereas in part of the quaternary period Jersey must have been affected by a land elevation which joined it to the adjacent mainland of France, Guernsey was not so joined. The absence of Upper Palæolithic man from Jersey, and the failure of intensive search to produce any certain evidence of mesolithic man even on the habitation site of Le Pinnacle, argues a subsidence in which Jersey once more became an island; but a further elevation and consequent union with France again is argued as possible for the megalithic period. This would account for certain differences observed in the culture of the island, upon which Mrs. Hawkes enlarges.

Whether Jersey was already occupied on the arrival of the megalithic culture, which is the most conspicuous element in the cultures of the Channel Islands, is a question which Mrs. Hawkes argues with much acumen on the complex evidence by excavation on occupation sites and mounds. For here, with the megalith and its associate the bell beaker, which, as Mr. Kendrick has pointed out for Guernsey, belong to the Morbihan and are derivate ultimately or in certain instances possibly more immediately from the Iberic peninsula, are also associated elements of the Chassey culture, the vase support being conspicuous in Jersey by the frequency of its occurrence, and another strain of the megalith, the long cist with holed stone, which is characteristic of the Seine-Oise-Marne culture. Arguing from an analysis of the culture of the adjacent Normandy-Breton mainland, Mrs. Hawkes sees in the characteristic culture of Jersey a culture peripheral to this region—assuming that Jersey was then joined to the mainland in which Chassey, SOM and the megalithic culture of the Atlantic coalesce, while the megalithic culture of Guernsey, in which the two former are absent, becomes a touchstone of a western origin for the elements of any given cultural complex.

That the megalithic culture of the Channel Islands persisted in degenerate form for a prolonged period and long after it died out elsewhere is more than probable. After this rich, not to say extravagant, efflorescence—a manifestation of local prosperity—dies down, neither island has anything to show down to Roman times that is at all comparable, with the exception of the remarkable gold torque found in Jersey, a find which is as puzzling to the archæologist as it is unexpected. The torque is in itself almost unique, for its length of 4 ft. 7½ in. makes it almost the largest known, being second in length only to the Tara torque, which is 25 cm. longer. Its weight is 476 grams. It belongs to a class which in Britain is assigned to the Middle Bronze Age; but its presence in Jersey, Mrs. Hawkes holds, is explicable only if its introduction into the island took place not in a period when the island was culturally poor, but rather in the later Late Bronze Age, when intercourse with Britain was intensified.

The remaining detail of the record must be passed over. Enough has been said to indicate the power of cultural analysis which Mrs. Hawkes has successfully, if as she admits not finally, brought to bear upon a cultural complex which is something in the nature of a jigsaw puzzle. She pays a just tribute to the work of the members of the Société Jersiaise, which in its turn has published her work with a lavish but deserved generosity, while in the honorary secretaries of the Society, Major Lacy Rybot and Mr. Emile Guiton, she has had as collaborators an artist and a photographer worthy of her text.

TRAVELS IN PERU

A Forgotten River
A Book of Peruvian Travel and Botanical Notes. By Christopher Sandeman. Pp. xii+300+15 plates. (London: Oxford University Press, 1939.) 12*s.* 6*d.* net.

A "THREE-MONTHS Odyssey" is told in diary form, a thousand miles circular tour through northern Peru, starting from Lima, following old trails better known in the seventeenth century than to-day. The Andean divide crossed at 16,000 ft., the Huallaga River was reached where it becomes navigable by rafts and canoes at 2,640 ft. above the sea. Four hundred miles here were practically forgotten; the last navigators were Smyth and Lowe in 1834, and Herndon in 1850. A raft was built of the light balsa (Ochroma) wood simply by lashing long poles together by lianes, the whole rather irregular and loose so as to give to the frequent collisions with banks and fallen trees as well as the strandings in shallow water. The three weeks voyage was exciting enough, rapids, whirlpools, canyons and waterfalls using up three rafts in succession, but it did not give much scope to the botanical proclivities of the passengers. The river showed remarkably little change in the hundred years that had elapsed. Its course was through tropical forest, part of the once Jesuit empire that continued throughout the seventeenth century to the expulsion of the order in 1768. It is useful to observe that this conquest was based on the natives' natural love for music, used in the first place as a lure and later as the governing feature of each community.

At Yurimaguas, 580 ft., the old east-to-west trail was reached and this was followed westward across the Andean Cordillera. It started as a mule trail through the tropical rain forest, innumerable streams and no bridges. Then from Moyobamba at 2821 ft. it became much worse as it crossed the first ridge at 12,000 ft., often in deep gullies created by the feet of traders from Inca and earlier civilizations, the higher parts of the ridge scored by the winds so that only stunted bushes and grass could grow. A descent to Chachapoyas, 7638 ft., strengthened the travellers to cross the Calla Calla Pass, then the descent to the Maranon River, whence the Amazon falls 3000 ft. to the sea in about as many miles. Again a further pass and finally the last part of the journey by motor along the completely bare and barren coastal plain.

There is little of scientific interest in this book of a plant-collector; but its simplicity, complete honesty and pleasant sense of humour cause it never to weary. The reader will form a better idea of this almost forgotten country from it than from a more pretentious work. The task of opening it up, with its numerous parasitic diseases and its unwanted products, is enough to depress any Government.

APPLIED AERODYNAMICS

Applied Aerodynamics
By Prof. L. Bairstow. Second edition. Pp. xviii+808+27 plates. (London, New York and Toronto: Longmans, Green and Co., 1939.) 63*s*. net.

THE first edition of this book was reviewed in NATURE of March 25, 1920. In general the appearance of a second edition of a standard text-book calls for little comment, but in the present case the changes are so far-reaching that the book is practically a new work. The period immediately before and during the War of 1914-18 was one of intensive pioneer research both on the theoretical and experimental side, and in this research Bairstow took a leading part. The first edition, based on the work done during that period, omits all reference to boundary layer theory, the Kutta and Joukowski theory of two-dimensional aerofoils, the circulation theory of lift, and the Lanchester-Prandtl theory of finite aerofoils. All this is remedied in the present edition, and for that reason alone it can be seen that the author's statement that about three quarters of the book is new material is easily justified.

The author has adhered to the general plan of the first edition, namely, to provide principles to interpret the results of experience, and to give adequate experimental results to illustrate the subject-matter.

The book opens with a short but interesting chapter on the history of the development of applied aerodynamics. Then follow chapters on the principles of flight, aerodynamic measurements, laboratory tests, aerial manœuvres, similarity and scale effect. The next five chapters start from first principles to build up the theory of aerofoils at moderate speeds when compressibility of the air is unimportant, and at high speeds when the properties of aerofoils are materially different from those at low speeds. These chapters contain detailed development of a large amount of ordinary hydrodynamical theory, potential, viscous, and two-dimensional boundary layer flow, including the detailed application to an actual aerofoil. There is also a short chapter introducing the statistical theory of turbulence.

The three remaining chapters deal with air-screws, performance, and stability. In connexion with stability the author explains that during the past twenty years economic pressure has led to intensive activity directed to increase of speed and load, and as a consequence a very large amount of information is available from which to choose illustrative examples of steady flying. The experimental investigation of more complex motions has been less thoroughly pursued and in particular there has been less systematic study. It has therefore not been possible to use modern examples to illustrate adequately the principles of stability, and for these sections the examples of the first edition have been retained. Nevertheless, an account of Glauert's non-dimensional system of equations would have been welcome here, as developed, for example, in the excellent study of stability given by B. Melvill Jones in volume 5 of Durand's "Aerodynamic Theory".

In the preface the author states that this book is in no sense an attempt to produce a text-book of designs, but aims at the extraction from the great mass of data of those elements which necessarily form the basis of all design. That this aim has been attained in full measure cannot be doubted. The book is full of apt numerical tables, graphs, and diagrams. There are also twenty-seven excellent plates, including one of the kite balloons now so prominent in the sky of London and elsewhere. Incidentally, an interesting conclusion from the investigation of the aerodynamic force on these balloons, is that the balloon is blown to a definite position by light winds, and will then maintain this position as the wind velocity increases.

The reviewer may perhaps be permitted two grumbles: (i) the apparent absence of definitions of common terms such as *aspect ratio* and *camber*, (ii) the very high price of this excellent volume.

L. M. MILNE-THOMSON.

THE THEORY OF NUCLEAR FORCES*

By PROF. R. PEIERLS,

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THE forces between the constituents of a nucleus are 'short-range' forces, which have no appreciable effect over distances of more than a few times 10^{-13} cm. Hence it is impossible to find the laws of force by extrapolation from large-scale observations (as in the case of Coulomb's law) and the only possible lines of attack are either, to deduce the law of force from direct observations on the properties of nuclei, or to derive them from some simpler, and more general, laws.

Using the direct experimental approach, it is best to start from phenomena which involve only two particles, since only these permit an unambiguous theoretical interpretation. This group consists of the properties of the deuteron, including its disintegration, and the scattering of protons and neutrons by hydrogen.

Practically all experiments are carried out in conditions in which the de Broglie wave-length of the particles is greater than the range of the forces, and this has the effect that one need consider only those states of motion in which the motion of one particle with respect to the other has no angular momentum. (In all other states of motion the centrifugal force prevents the particles from approaching sufficiently close for any interaction to take place.) Moreover, so long as the wave-length is greater than the range of the force, the effect of the field of force is largely independent of the exact variation of force with distance within the range, and depends approximately only on one constant, which may be called the 'strength' of the field of force. (In the case of a potential of the type of a potential well, this strength is approximately proportional to the depth times the square of the width.)[1]

In the experiments on proton–neutron interaction two possible cases are discussed, according to whether the spins of the two colliding particles are parallel or opposite (in the case of like particles, Pauli's principle ensures that, so long as there is no orbital angular momentum, the spins are necessarily opposite) and the strength of the interaction may be different for these two cases. For the case of a proton and a neutron with parallel spin, the strength constant can be obtained from the binding energy of the deuteron; for those with opposite spin, it follows from the scattering of neutrons by protons, since in this scattering the effect of the neutrons with parallel spin can be allowed for once their strength constant is known. The very high cross-section for slow neutrons is an indication that the strength constant of the interaction for neutrons with opposite spin is either just sufficient or just insufficient to give rise to a bound state of the deuteron with no resultant spin[2]. The choice between these alternatives can be made by means of the scattering of neutrons in *para-* and *ortho*-hydrogen where, because of interference, the results depend on the phase of the wave scattered by each proton. The result is that the force is just insufficient to give a bound state[3].

For the proton–proton force, the strength can be derived from measurements of the scattering of protons in hydrogen.

Once these strength constants are known it is possible to calculate all other observable quantities, namely, the energy variation of the proton–proton and neutron–proton scattering, the photo-effect of the deuteron, etc., to the degree of approximation in which the ratio between the range of the forces and the de Broglie wave-length is negligible. The fact that these calculations give approximate agreement with observations serves as a check on the initial hypothesis of short-range forces.

Actually, all results of this simple theory have to be supplemented by correction terms involving the range. If the experimental data were accurate enough, it should thus be possible to estimate the range of the forces. The use of these correction terms requires greater accuracy than is at present available in the data on neutron–proton scattering, and the determination can only be carried out in the case of the proton–proton scattering, in which more accurate data have been obtained. The result of this is that the 'range' for this interaction is about $1\cdot2 \times 10^{-13}$ cm. The experimental data are even accurate enough to yield a certain amount of information on the actual dependence of the force on distance[4].

More information on these points would be obtained by measuring the neutron–proton scattering at medium energies with higher accuracy, or by observations at higher energies including, in particular, the angular distribution of the scattered particles.

An important contribution to the problem was the discovery by Rabi and others of a quadripole moment of the deuteron[5]. This proves that the neutron and proton have a tendency to have their spins in the direction of the line joining them, rather than at right angles to it. This implies obviously that the forces are not central, but that the potential energy depends on the angle between the spin direction and the line joining the two particles. Although all the calculations referred to above were carried out on the assumptions of central forces, the results remain practically unchanged. For opposite spins, which is the only case of interest for proton – proton interaction at low energies, the force must still be central, since the resultant spin is zero and hence does not set up a preferential direction; for parallel spin, the fact that the force is not central means that the angular momentum due to the motion of the particles is no longer constant but fluctuates. Hence the motion in the state of lowest energy is no longer one with zero orbital angular momentum; it can be shown that the state of motion is a mixture of a state with zero angular momentum and one with two units (*S* and *D* states in spectroscopic notation). From the electrical quadripole moment one can estimate that the contribution of the *D* state amounts to only a few per cent[6].

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*Based on lectures given at the Royal Institution on January 17, 24 and 31.

However, an appreciable non-central force is required to produce even this small effect, since in the *D* state a very strong centrifugal force has to be overcome. It seems probable, therefore, that the non-central forces must represent an appreciable fraction of the total force. Yet, again owing to the effect of the centrifugal force, no appreciable influence of this *D* state should be expected on the other observable phenomena, except possibly on some finer features which have not yet been thoroughly investigated. Thus the approximate agreement with the experimental evidence, and the estimate of the range remain practically unaffected by the correction terms.

The data on the strength and the estimate of the range give the same answer, within the experimental error, for the proton – proton and proton – neutron interactions for opposite spins, and the suggestion has therefore been made that these two forces are exactly the same, except for the electrostatic interaction between the protons ('charge-independence hypothesis')[7].

From the fact that the charge of stable light nuclei is about half their mass, and that only a small change is produced in the energy of a light nucleus if in its constituents the number of neutrons and the number of protons are interchanged, has further led to the belief that the nuclear forces are symmetric in proton and neutron, that is, the neutron – neutron interaction is exactly the same as the proton – proton interaction, except for the effect of the electric forces[1].

Turning now to the evidence from nuclei containing more than two particles, this is usually discussed on the basis of the assumption that the forces are additive; that is, that the interaction force between two particles is not affected by the simultaneous presence of a third particle. Beyond its simplicity and the fact that it holds in the atom, this assumption is not founded on any evidence, and, in fact, there are certain theoretical arguments against it[8]. However, without this assumption the available evidence is insufficient to draw any conclusions at all, and one must therefore use the assumption of additivity as a working hypothesis, which may at a later stage be disproved. Moreover, most of the theoretical work on the nuclei of weight 3 and 4 was done before the discovery of the quadripole moment of the deuteron, and hence central forces were used. It is likely that the directional dependence of the force will not be negligible in these problems, but its precise effect has yet to be investigated.

So far as the calculations go, they show that the mass defects of the nuclei of mass 3 and 4 are very sensitive to the range of the force, and that the range required to give the right values is roughly of the same order of magnitude as that obtained from scattering experiments[1,9]. Quantitative agreement, however, was not obtained. The laws of force used in these calculations were usually restricted by adopting the charge-independence hypothesis, and also by assuming that the range of the force was the same for parallel and for opposite spins. Whether the remaining discrepancy is due to these restrictions, or to the assumption of central forces, or whether it represents a failure of the additivity, remains to be seen.

For nuclei beyond ^{4}He, the observed binding energy ceases to rise rapidly with the number of particles. This fact, often briefly referred to as 'saturation', obviously means that the constituent particles of a large nucleus do not *all* attract each other with the same forces with which the constituents of a helium nucleus attract each other. This may be due to several reasons. For one thing, the additivity of the force might fail, and the attractive force between two particles may depend on the number of other particles in the immediate neighbourhood. This dependence might be such as to ensure that the total potential energy per particle always remained below a certain saturation value. A possible description on these lines has been put forward by Teller, Critchfield and Wigner[10], but the idea has not yet been pursued very far.

Another possibility is that the attraction may turn into repulsion at very close approach, in analogy with the forces between the atoms of a liquefied inert gas. In this case the repulsion might ensure that any one particle can, within the range of its forces, be surrounded only by a small number of others, and hence the binding energy per particle is again limited. This possibility has not been fully explored, but it has the disadvantage that, owing to the wave mechanical penetrability of potential barriers, an extremely strong repulsion would have to be assumed to make this explanation possible.

The most attractive explanation is no doubt that the forces are 'exchange forces' which depend on the symmetry of the wave function describing the motion of the particles, like the valency forces between the constituents of organic molecules. On this idea the neutron is trivalent, capable of forming a 'bond' with one other neutron and two protons, and correspondingly for the proton. This would give a very natural explanation of the helium nucleus as a saturated structure[1].

The directional properties of the forces, which must be inferred from the existence of the quadripole moment of the deuteron, may have a bearing on this question, since in a large nucleus different particles must necessarily be arranged in different directions relative to a given particle, and the forces may quite well be attractive for some pairs of particles and repulsive for others, if the directional dependence of the forces is strong[6]. This effect will give rise to some kind of saturation; whether this saturation is of the right kind, and in particular whether it leads naturally to the α-particle as a stable structure, remains to be seen.

Of the attempts to derive the nuclear forces from a more elementary phenomenon, the most interesting is the meson theory, which is based on an idea of Yukawa[11]. Yukawa supposes that the nuclear forces are due to a 'nuclear field' in the same manner in which the electromagnetic forces are caused by the electromagnetic field. This field must, however, satisfy different field equations in order to produce short-range forces, and if this requirement is coupled with that of the principle of relativity, there is only one possible type of wave equation, and the law of interaction is limited to laws of a particular type, of which the simplest has the potential:

$$V = g.e^{-kr}/r, \qquad (1)$$

where k and g are constants, and r is the distance between the particles. (Coulomb's law is a special case of this with $k = 0$). In quantum theory, just as the electromagnetic field is associated with light quanta, the 'nuclear field' will be associated with a new type of particle; the fact that the wave equation differs from that of light indicates that the rest mass of these particles is not zero, like that of light quanta, but has the finite value $hk/2\pi c$, where k is the same constant as in (1). In order to obtain a range of the right order of magnitude this mass has to be assumed to be a few hundred times that of the electron. The subsequent discovery of 'mesons' of just such a mass in cosmic rays has very much increased our confidence in the 'meson theory' of nuclear forces.

If we try to fit a law of the form of (1) to the observations on proton-proton scattering, we obtain very good agreement, but we have to choose a value of k which corresponds to a meson mass of about 300 electron masses. This is almost certainly higher than the mass of the mesons found in cosmic rays. The origin of this discrepancy is not clear.

On the meson theory of nuclear forces, mesons are capable of being absorbed and emitted in nuclear reactions provided sufficient energy is available for their creation, and they may be exchanged (that is, temporarily created by one particle and absorbed by another) even if the available energy is insufficient to liberate them. If this view is taken, conservation of angular momentum in the process requires the mesons, like light quanta, to have integral spins. (The electron, which has a half-integral spin, can only be absorbed or produced in pairs.) Zero spin would make the nuclear forces repulsive when they should be attractive, and the most likely assumption seems that of a spin of one unit, as for the photon[12].

This assumption fixes the equations of the meson field completely, but not its interaction with the proton and neutron. This interaction is governed by two terms which, by analogy with the electric charge and magnetic moment, one may term the 'meson charge' and the 'meson moment' of the heavy particles. The law (1), in particular, is obtained if the heavy particles have only a meson charge g, but no meson moment. This law does not agree with experiment in detail, since it gives neither a spin dependence of the force (as required to explain the properties of the neutron-proton scattering) nor a directional dependence that would account for the quadripole moment of the deuteron. The introduction of a 'meson moment' would help to give the right dependence[12], but the force would then increase so rapidly at short distances that the proton and the neutron would fall into another, producing an infinite binding energy. Probably this result should not be taken too seriously, since the methods of quantum theory are likely to fail for too close approach, but it would mean in any event that the quantitative study of nuclear forces would have to be abandoned until an exact description of this failure of quantum theory is available.

It has also been suggested that two kinds of mesons might exist, of which one has the spin one, the other zero spin, and with such properties that the singular terms in the interaction energy just cancel. In the crude approximation to which such calculations are usually carried out, the directional dependence of the forces would then also just cancel, together with the infinities, but it is possible that finer effects would give a sufficiently large directional variation.[13]

Lastly, there arises the question as to the electric charge of the meson. The mesons observed in cosmic rays are charged, and if one of them is emitted by one nuclear particle and absorbed by another, this will involve an exchange of charge, thus ensuring that the forces are of the exchange type, as required by the most widely accepted explanation of the saturation of nuclear forces. Such an exchange will, however, be possible only if one of the heavy particles is a proton and the other a neutron, but not for two like particles. In order to account for the equally strong forces between like particles, one has to assume the existence of neutral mesons in addition to the charged ones[14]. There is certain independent evidence for the existence of neutral mesons in cosmic rays[15]. If we take the view that the saturation of the nuclear forces is due to their directional dependence and not to their exchange character, it is, in fact, possible to attribute *all* nuclear forces to neutral mesons[6]. This would have the advantage of removing the discrepancy between the mass of the charged mesons from cosmic rays, and the range of the forces as determined from proton–proton scattering. It would mean, on the other hand, that the particles, the discovery of which was hailed as a confirmation of Yukawa's theory, had actually no connexion with the particles postulated by Yukawa.

This summary of the present state of the theory[16] closes with a number of questions to which the answer is not known. But the fact that it is possible to ask these questions at all is a sign of the rapid progress that has been made in this field in the last few years.

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BREEDING DISEASE-RESISTANT PLANTS

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THE possibility of raising varieties resistant to virus, bacteria, fungi, and insects is an attractive prospect for the practical plant breeder. Potatoes immune to wart disease, beans resistant to anthracnose, wheat resistant to rust, vines resistant to *Phylloxera*, and wheat, barley, and oats resistant to Hessian fly, eelworm, and frit fly are sufficiently well known to encourage the investigator to work on other crops. Several publications (Roemer, Isenbeck and Fuchs, Lesley and Wallace, Reddick, Painter, Jones, Johnston and Parker) have recently directed attention to different aspects of this question. The following short account is based on these publications. The accompanying table lists a few commercial crops which contain disease-resistant varieties.

TABLE I

Potatoes: *Synchytrium endobioticum*, *Phytophthora infestans*, *Alternanthera solani*, *Bacterium phytophthorum*, *Actinomyces scabies*, *Leptinotarsa decemlineata*. Virus A, B, C, X, Y.
Tomatoes: *Cladosporium fulvum*, *Fusarium lycopersici*, curly-top virus.
Cabbage: Yellow virus, *Fusarium*.
Turnip: *Plasmodiophora brassicae*.
Cotton: *Bacterium malvacearum*, *Fusarium vasinfectum*, leaf-blister mite, black scale, jaccid insects.
Beans: *Colletotrichum Lindemuthianum*, *Phytomonas medicaginis*, *Erysiphe polygone*, *Fusarium solani*, *Uromyces appendiculatus*. *Heterodera*.
Celery: *Fusarium Orthoceras*, yellow (virus).
Antirrhinum: *Puccinia Antirrhini*.
Apple: *Venturia inæqualis*, *Eriosoma lanigerum*.
Vines: *Plasmapara viticola*, *Uncinula necator*, *Phylloxera vitifolii*.
Wheat: *Puccinia graminis*, *P. glumarum*, *P. triticera*, *P. coronifera*, *Tilletia*, *Ustilago*, *Phytophaga destructor*, *Erysiphe graminis*.
Barley: *Heterodera Schachtii*, *Puccinia graminis*, *P. glumarum*, *P. dispersa*, etc., *Erysiphe graminis*, *Ustilago nuda*.
Oats: *Oscinis Frit*, *Puccinia* spp., *Ustilago avenæ*, *U. levis*.
Pisum: *Grapholita* sp., *Bruchus pisi*, *Ascochyta*.

There are several points of interest in the relationships of the hosts and diseases enumerated in this incomplete table. There is a large number of cases where the genetics of resistance is complex. Several times (wheat, tomatoes, beans, etc.) the character was shown by the early workers to behave in a monofactorial Mendelian manner. Later, the mode of inheritance was found to depend on interacting, cumulative, or duplicate factors. Thus resistance against *Synchytrium*, *Phytophthora*, *Puccinia graminis*, *Plasmapara*, *Erysiphe*, *Cladosporium fulvum*, and woolly aphis is inherited in a complicated manner. Polyploidy of potatoes, wheat, oats, and apples will account for some of the complications, and to some extent the geneticist can cope with such problems. They could be dealt with by normal breeding procedure if resistance were an easily diagnosed trait, and behaved as a stable characteristic. Resistance, however, varies continuously in some cases, from high resistance to susceptibility, and frequently resistance has to be measured quantitatively. For example, the percentage of plants which are attacked, the percentage which prevent the normal development of the larvæ, and the percentage which survive attack, all determine the resistance of a strain of wheat to Hessian fly. A more serious difficulty, however, is the fact that the attacking agent is also a living thing and consequently productive of variations. Biffen showed that black rust resistance in wheat behaved in a simple Mendelian manner. Pole Evans and others questioned the stability of the resistant forms. The apparent breakdown of the resistance is accounted for when it is realized that black rust consists of a considerable number of different strains—physiological races. These races are in large part due to mutation and segregation during sexual reproduction. They differ from one another in their virulence and in their comparative effect upon the different varieties of the host species. The establishment and the specialization of these races is a most interesting problem. For example, the resistance of varieties of beans to three physiological races, α, β, γ, of *Colletotrichum Lindemuthianum* is:

Bean variety	*α*	*β*	*γ*
Wachs Protecta	0	++	++
Doppelte Hollande Princess	++	0	0
Krummschnabel	±	++	0

(After Schreiber.)

When the number of physiological races is increased (see Table 2), the specialization of the fungal races may upset much of the plant breeder's work. On several occasions (for example, wheat, potatoes) a variety resistant to a fungus has been produced, but soon this variety comes into contact with another physiological race of the fungus against which it is not resistant.

Table 2.

Minimum number of physiological races found in some fungi.

Puccinia graminis	160
Puccinia glumarum	31
Puccinia triticina	91
Helminthosporium graminium	4
Erysiphe graminis	15
Venturia inæqualis	111+
Colletotrichum Lindemuthianum ..	50
Phytophaga infestans	4
Tilletia spp. (on cereals)	20+
Ustilago spp. (on cereals)	20+

The diagnosis of immunity, resistance, or susceptibility would be facilitated if some anatomical or physiological characteristic of the host plant could be found to be the cause of, or to be strongly associated with, immunity. The cutinization of the epidermis of *Pisum* and distribution of sclerenchyma in cereals are associated with resistance to *Aschochyta pisi* and *Puccinia graminis* respectively, while the degree of attack of *Gibberella Saubinetti* upon wheat and maize is proportional to the state of the sugar in the transition of hexose-pentose (J. G. Dickson). The more pentose the more resistant is the crop. Resistance and immunity are, unfortunately, often bound up with the biochemical and physiological reactions of the living plant. Further research work is required before the identification of these reactions can be attempted.

Commercial breeding usually does not wait for the results of the analysis of the relationship between host and fungus, but it is rarely possible to obtain success in breeding for resistance without the help of the scientific worker. The evolution of methods of testing resistance as in wart disease, of methods of crossing based on cytology as against *Phytophthora infestans*, the introduction of new species and the study of the environmental conditions under which resistance is increased are essential to the success of the practical breeder. One or two accounts of recent breeding work will indicate the wide field and problems that are normally encountered.

Blight due to *Phytophthora infestans* causes considerable damage to the potato crop. Reduced cropping, costs of spraying and other palliative measures would be greatly alleviated by the existence of varieties of potato resistant to the disease and equal to the present susceptible variety in quality and yield. Obviously, one of the first problems in the attempt to breed disease-resistant varieties is to discover whether any potato or relative of the potato shows resistance to the disease. The analysis of collections from South America made by Baur and Schick, Reddick, Hammarlund and the Russians have shown that *P. infestans* is not epiphytotic in South America, and therefore, in the absence of a basis for natural selection, we do not expect to find, except by accident, a resistant variety. All evidence indicates that the great *Phytophthora* epidemic of 1845 was of European origin and was the first occasion on which *P. infestans* and the potato met. Various non-tuberous species of *Solanum* and neighbouring genera contain immune varieties, so it does not seem unreasonable to expect that species hybridization might achieve the end in view.

Many attempts in hybridization and selection have been made by Müller, Salaman, Sutton, Reddick, Kattermann, Schick, and others. Immunity and resistance are inherited and transmitted to the progeny of crosses within *S. tuberosum*, or between *S. tuberosum* and other species, notably *S. demissum*. The mode of inheritance is variable, like immunity to wart disease. Where *S. demissum* is used as parent, the F_1 and most of the F_2 generations are immune ; when resistant varieties of *S. tuberosum* are crossed, the F_1 is susceptible, but some of the F_2 are resistant (see Schmidt, Salaman, Reddick). It is probable, as pointed out by Müller, that the polyploid nature of the potato and its relatives is the cause of the peculiar dominance, and segregation results. The potato is notably difficult to breed since many varieties have almost inviable pollen, and breeding is restricted to a few of the commercial varieties. The potato is tetraploid, while *Solanum* species may be diploid, triploid, tetraploid, or hexaploid ; *S. demissum* is hexaploid and has fertile pollen and ovules. Unfortunately, the cross $6n \times 4n$ (where the pollen of the potato, such as it is, has to be used) is the only way in which much success can be obtained in making this cross. When the F_1 is obtained, it is immune to blight and self-fertile, but very dissimilar from any potato. The long stolons of *S. demissum* are even longer in the F_1 and the tubers are very small and few (Reddick). The F_2 and succeeding generations are quite useless for selection (Reddick, 1940). Back-crossing to the potato is laborious but does produce more promising results. Immunity is now restricted to about 40 per cent of the progeny, but the immune plants are not of much value as potatoes. Continued back-crossing, like selfing, greatly reduces vigour, and one is rewarded by weak, dwarf plants with no power to form tubers.

These methods would be difficult enough if blight was a stable entity, but it is a fungus which is even more plastic than the rusts. New biological races are being formed frequently ; in Europe the formation of sexual oospores gives an opportunity for segregation, but in America, where oospores are apparently not formed, new races are also produced asexually. Berg and Röder showed that tomato late blight was a different physiological race from those of the potato, and recently (Mill) it has been shown that this tomato blight is synthesized annually from potato blight. Therefore there are true biological races and peculiar strains with distinct degrees of infection potency. For example, Reddick states that one artificial infection of the varieties President and Green Mountain will show few lesions on the President and large ones on Green Mountain, which is susceptible. But if two passages through President are made, the degree of virulence of *P. infestans* is increased so that lesions on Green Mountain and President are both large and indistinguishable. Further, Reddick and Mills have shown that even after twenty passages through the susceptible Green Mountain the higher virulence is maintained. Reddick has shown that, if there are bridging varieties of intermediate susceptibility, the virulence of *P. infestans* can be stepped up to a high degree from a culture which originally would only infect the most susceptible. Thus Reddick suggests that it is probably feasible to break down the immunity even of *S. demissum* if bridging varieties for stepping up the virulence were available. The presence in Europe of definite physiological races which possibly have arisen from sexual reproduction further complicates matters. Müller, Schick, Kattermann, and others have isolated races which are specialized in respect to the varieties which they do or do not attack.

Although these complications are encountered, several workers have succeeded in raising potatoes of fair commercial value which are resistant to the present condition of *Phytophthora infestans*. It is unfortunate, however, that the prevalence of virus disease among potatoes probably leads to greater difficulties in the commercial growing of potatoes in Great Britain than attacks of blight. Some varieties are immune, some are carriers without showing infection and others are susceptible to one or more identified viruses. Craig's Defiance, produced by the Scottish Society for Research in Plant Breeding, is field-immune to viruses A, B, C, and X. The combined study of the etiology of the disease and of the reactions of potatoes to the different viruses is yielding highly important results. Resistance to virus diseases is inherited in sugar cane, cucumber, sugar beet, cabbage, celery, tomato, and other crops.

The reaction of the host plant to attack by virus is a peculiar one (see K. Smith). Lesley and Wallace have shown that some strains of the tomato may exhibit 'recovery' from an attack of curly top virus. The appearance of 'curly-top' appears about twelve days after infection in the field. Sometimes recovery by the regeneration of new shoots takes place, and if this is early enough the tomato may produce fruit. The degree of recovery is a racial characteristic, but is also influenced by environment. Clones from a recovered plant also show a resistance to further infection by curly top. For example, out of twenty-three recovered plants which were inoculated again, nineteen showed no symptoms of the virus. On the other hand, nineteen out of twenty-seven fresh plants showed curly top symptoms after inoculation. The virus is present in the recovered plants and its virulence on fresh plants was unchanged. Similar effects can be found in the tobacco ring-spot virus disease.

The saving of the sugar-cane in Java by synthesizing hybrids of several species including wild *Saccharum spontaneum* and crossing these to *S. officinarum* is now historic. The immunity to virus derived from *S. spontaneum* could not be introduced into *S. officinarum* until the effects of the chromosome constitution upon hybridization were realized. The 'ennobling' of the sugar-cane has increased its yield, sugar-cane control, and created immunity to diseases (Bannier, Janaki-Ammal).

Parker, Jones, Johnston and Painter have recently reported the results of combining resistance to Hessian fly attack with resistance to other pests and diseases in commercial wheat. There are strains of wheat which are resistant to Hessian fly, which lays its eggs in the seed, about the end of March; the larvæ bore between the stalk and leaf sheath, and the plants shrivel and die. Resistance to Hessian fly attack is heritable, but the mode of inheritance is involved. In some cases, the larvæ develop without the plant showing damage, and in others a low amount of oviposition takes place. Of 327 American varieties, 106 gave resistant strains (only 10 per cent attack, as compared with 40 per cent susceptible in Kanred). Painter and his collaborators have recently combined the high Hessian fly resistance of Marquillo wheat with the best winter wheats. Forms are now known which show resistance to stem rust, rust, mildew, joint worm, and Hessian fly, and are equal to the best commercial winter wheats. The combination of these strains into one variety promises to give highly important commercial results. Already the Marquillo hybrids of winter wheats show low survival of larvæ of Hessian fly, low percentage of plants attacked, and a high survival rate of plants attacked under high fly infestations. These Marquillo wheats are the first to combine resistance to insect and fungus attack, and to show resistance to Hessian fly in all the wheat belts of America.

It is interesting to note that physiological races are also present in other animal enemies of commercial crops. *Heterodera Schachtii*, *Phylloxera*, for example, have been found to have races specialized for certain varieties of a species or to certain species (*Heterodera*) (see W. H. Thorpe).

The occurrence of physiological races in insects, fungi, and, for all we know, in virus diseases, deserves special consideration by the geneticist. We know from the work of Stakman and others that the characteristics which differentiate between physiological races in rusts and smuts segregate in crosses between these different races. Also we know that mutation occurs both in sexual and in asexual generations. Rarely is there any morphological difference between these races; but fungi such as *Venturia inæqualis* produce many morphological variants on one apple. The nature of the resistance of the host variety is not simply a quantitative degree of virulence, but there is a qualitative difference respecting host varieties attacked. The simple example of *Colletotrichum*, quoted above, may be extended to the larger number of varieties available in the host species.

How did these physiological races spread after their origin by mutation or segregation? The origin of new physiological races in the asexual generation, as in the *Phytophthora* case of Reddick, mentioned earlier, is intriguing. It will be noted that virulence is only stepped up when bridging strains of the host variety are present. It might appear, therefore, that environment was creating the new variant. It is more probable that somatic mutation is continually going on. In a susceptible variety *A*, selection is neutral, and the size of the population of a more virulent mutant is small; therefore, as shown by Sewell Wright and Dobzhansky, the variant will tend to disappear. If, on the other hand, there is a bridging variety, selection for the virulent variant becomes positive, and the population grows in size. Therefore the more virulent strain of fungus is ready in the bridging variety in sufficient amount to infest the more resistant host variety *B*. Once established there, the less virulent race of fungus tends to be swamped. Specialization of a fungus race to a particular variety would arise if the virulent race of fungus became modified by mutation and selection in such a way that it would not attack the original susceptible variety *A*.

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OBITUARIES

The Right Hon. H. A. L. Fisher, O.M., F.R.S.

DEATH has been taking a heavy toll of eminent Oxford men within the last few months. First, Prof. Joachim died about a year ago; then his intimate friend Prof. J. A. Smith; then Prof. Samuel Alexander, who had made his name at Lincoln College before he went to Manchester. Then, on April 18, came the death of Mr. H. A. L. Fisher, who was, of course, much the best-known public man of the group. In one way he must surely have been unique, in giving many years of service as a Minister of the Crown and then having a long tenure of the wardenship of New College, Oxford.

Fisher was taken into the war cabinet as Minister of Education by Mr. Lloyd George—to whom he was always much attached—in the year 1916 when the great changes were made which displaced Lord Asquith. He remained as Minister of Education until 1926 and used his position to make the most vigorous efforts to raise the standard of national education by raising the age for leaving school and in other ways improving the chances of education for young people when they came to leave. In these efforts he gained the hearty support of the whole teaching profession, whose status he considerably improved by raising the salaries of masters and mistresses in secondary schools.

No one perhaps has ever deserved so much of the whole body of teachers and scholars as did Mr. Fisher. It will be remembered that it was found impracticable to carry out at once the raising of the age which his Act proposed. The matter was left in abeyance and in constant dispute until the present Government took it up again two years ago and—with certain reservations—at last made the Fisher Act a living thing. How it will work remains to be seen when the modifying Act is at last to be put in operation.

On leaving the Ministry in 1926, Fisher went back to his old College, this time as head, for he had been by education a Winchester and New College man. He remained as warden of New College until his death, and was one of the best-known and respected figures in Oxford.

In the world of letters he became best known by his "History of Europe", which quickly rose to the distinction of a best-seller. It was published in 1936 after intense labour which reduced Fisher to a chronic state of weak health for the last three or four years of his life. He tells us in the preface that his subject is "Man from the neolithic age to Stalin and Mustapha Kemal, Mussolini and Hitler". But he damps the hopes of believers in progress by saying that "one intellectual excitement has been denied me. Men wiser and more learned than I have discerned in history a plot, a rhythm, a predetermined pattern. These harmonies are concealed from me. I can only see one emergency following upon another as wave follows upon wave. There can be no generalization, only one safe rule for the historian; that he should recognize in the development of human destinies the play of the unforeseen and the contingent". It was true indeed in the course of his own life, for who could have foreseen that the best-known historian in England and the leading figure in Oxford academic life would have been struck down at last by a lorry on Millbank. His friends had been anxious for his health for some years. They thought that he would yield to the strain of excessive and prolonged intellectual work. But no! It was the contingent, a passing lorry, which might have carried away any insignificant citizen of London, which ended one of the most active and distinguished lives of our day.

F. S. MARVIN.

Prof. S. M. Dixon, O.B.E.

PROF. STEPHEN MITCHELL DIXON, who died on March 25 at Nice at the age of seventy-four, was a leader in civil engineering education. Born in Dublin, he studied experimental physics and carried out research under Fitzgerald at Trinity College, and then qualified in civil engineering. After experience as contractor's engineer on railway works in England he was appointed to a newly established chair of civil engineering at Fredricton, New Brunswick, in 1892. Ten years later he moved to Dalhousie University, Nova Scotia, and in 1905 was called to Birmingham to organize the Department of Civil Engineering. When, in the general re-organization following the formation of the Imperial College of Science and Technology, the Mechanical and Civil Department of the City and Guilds (Engineering) College was divided into two autonomous departments in 1912, Dixon was called to the chair of civil engineering there.

Dixon was a great teacher who had the gift of infecting those around him with some of his own unlimited enthusiasm and of getting the best out of his students and staff without apparent effort. He had the probably unique record of having started four university departments of civil engineering. Dixon's approach to his subject was practical rather than theoretical, and he combined a sound foundation of the mechanical principles with a deep distrust of complicated theories and involved calculations. His fertile and active mind led him to devise many new ways of tackling well-known problems—a typical example was the use of a sand core for moulding pre-cast hollow concrete blocks. Old students will remember how he built a house, almost unaided, to prove the practicability of this pre-cast block.

In his earlier years, Dixon carried out research on terrestrial magnetism and on surveying instruments, but the ampler resources at Birmingham enabled him to begin the large-scale experiments on structural members which were perhaps his most important contribution to engineering science. This method of investigation was first applied to reinforced concrete beams, slabs and arches, and afterwards, at the Imperial College, to mine supports—steel and concrete arches for roadway lining, and cogs, chocks and packs for face support.

At Birmingham, Dixon carried out investigations on wire ropes and on supports for the coal mining industry, and this work was resumed when he was appointed to the Safety in Mines Research Board in 1923. He acted as chairman of the Wire Ropes Research Committee, and organized international co-operation in these investigations. Dixon was also a member and sometime secretary of the Institution of Civil Engineers Committee on the Deterioration of Structures in Sea Water, and carried out a long series of investigations on the preservation of Empire timbers from attack by Teredo. He served on the British Standards Committees dealing with wire ropes and steel arches for mines, and also on the testing of timber and the rating of rivers. In the large hydraulic laboratory at the Imperial College various investigations on current meters, syphons, and river models were carried out under his direction. For his work describing the measurements of the flow of the River Severn in 1921–36 he was awarded a Telford Premium of the Institution of Civil Engineers.

No record of Dixon's life would be complete without a reference to his outstanding services during 1914–18. In the very early days of the Ministry of Munitions he became personal assistant to Sir Henry Fowler, director of production, and was actively engaged in the organization of the great department until relatively stable conditions were reached in 1917, when he resigned to join the Royal Engineers. After ten days training he went to France on railway construction, and was demobilized as a captain in 1919. Dixon retired from his chair at the Imperial College in 1933.

M. A. HOGAN.

Profs. Jan Włodek and Adam Różański

PROF. JAN WŁODEK was one of the seventeen Cracow professors who recently died as a result of ill-treatment by the Germans in the concentration camp at Sachsenhausen, near Berlin. This was a disused brewery, had no accommodation for human beings and, although not quite as bad as the notorious Dachau and Buchenwald camps, was utterly unfit for human habitation. Along with 149 of his colleagues, he was arrested by the Gestapo, the accusation being, to quote the official Polish report:

"(1) vu que les professeurs ont essayé de reprendre les cours de l'Université sans que les autorités allemandes eu aient connaissance ;

"(2) vue qu'ils ont continué leurs travaux dans les institutions et séminaires dont ils étaient à la tête et faisaient passer des examens sans en demander l'autorisation ;

"(3) vue que, pendant 5 siècles, l'Université de Cracovie a été un bastion de l'esprit polonais. . . ."

He was by no means a robust man and as soon as his friends heard that he had been arrested it was feared he could not survive the cruelties to which he would be exposed, nor did he.

Prof. Włodek belonged to the old Polish nobility, had studied in Poland and in Switzerland, working especially on plant nutrition and soil problems and also on plant breeding. When the new Polish State was set up he, as one of the followers of Pilsudski, was appointed to consular work in Holland, but soon returned to the University of Cracow as professor of agriculture. Here he set up a large laboratory and was put in charge of the University Experimental Farm of Mydlniki. He was an excellent teacher and attracted many pupils, two of whom had already become professors at other Polish universities. Almost from the outset he was attracted to Willstätter's investigations on chlorophyll and was especially interested in the ratio of chlorophyll A to chlorophyll B, which he considered played an important part in the development of plants. He studied the relation between this ratio and the environmental conditions, particularly variations in the amount of nitrogen and of potassium supply. The other branch of his work was ecological and dealt with the distribution of plants in the Tatra Mountains in relation to the humus and calcium conditions of the soils and their pH values.

He had travelled widely in Europe and was a remarkably good linguist, speaking and writing English perfectly. He was a delightful host and those who have been privileged to visit him in his attractive ancestral home at Dabrowica will not easily forget his wide culture, good taste and charming personality.

Another victim has been Prof. A. Różański who, before the War of 1914–18 had held an important post in the Government in connexion with land surveying and improvement. After the War he was appointed professor of agricultural engineering and surveying in the University of Cracow and did a good deal of work on land drainage, particularly important for the development of agriculture in many parts of Poland. He showed considerable ingenuity in designing inexpensive and efficient methods of draining. He rendered great service to Poland in a quiet and unobtrusive way and was much liked by his students.

E. J. RUSSELL.

We regret to announce the following deaths:

Dr. Carl Bosch, president of the I. G. Farbenindustrie, the German dye trust, on April 27, aged sixty-six years.

Dr. Charles Davison, the authority on earthquakes, on April 28, aged eighty-one years.

Sir William Meade-King, the well-known civil engineer, on April 10, aged eighty-one years.

NEWS AND VIEWS

Dr. T. A. Henry

THE Wellcome Foundation recently made a presentation to Dr. T. A. Henry to mark the completion of his twenty-first year of service as director of the Wellcome Chemical Research Laboratories. Dr. Henry began his research career as a Redwood scholar in the Research Laboratories of the Pharmaceutical Society, whence he moved to the Scientific and Technical Department of the Imperial Institute, where he held a Salter's Company research fellowship and ultimately became superintendent of laboratories. He was appointed to his present post in 1919. Dr. Henry has done much original work on natural products, particularly cyanogenetic glucosides and alkaloidal drugs, while in his applications of chemistry to progress in medicine he has covered a very wide range of subjects.

During his directorship of the Wellcome Chemical Research Laboratories, Dr. Henry has given considerable attention to the chemotherapy of tropical diseases, including hookworm, leprosy, kala azar and malaria. This has involved investigations on the chemistry of organo-metallic compounds of arsenic, antimony and mercury, and has led, among other things, to a thorough examination of apoquinine, apoquinidine, niquidine and niquine and to the elucidation of their chemical constitution. Recently, the laboratories under his direction have been exploring the relationship of chemical structure and bactericidal action in the new group of drugs starting from sulphanilamide. In 1927, Dr. Henry was awarded the Hanbury Medal, which is given periodically by a committee including the presidents of the Chemical, Linnean and Pharmaceutical Societies for "high excellence in the prosecution or promotion of original research in chemistry and natural history of drugs". He is the author of the well-known text-book on the "Plant Alkaloids", of which a third edition was issued last year.

Scientific Research and Taxation

AT a time when the financial position of learning and scientific research is a matter of serious concern, no little interest is attached to the decision of a Divisional Court when Mr. Justice Hawke, Mr. Justice Charles and Mr. Justice Tucker on April 25 dismissed an appeal by the School of Oriental and African Studies of the University of London (*The Times*, April 26). The appeal was from the decision of the County of London Quarter Sessions that the School was not exempted under Section 1 of the Scientific Societies Act, 1843, from the payment of rates in respect of certain premises occupied by it. The provisions of this Act, by which a "society instituted for the purposes of science, literature, or the fine arts exclusively" may be exempted from the payment of rates, but of which full advantage had not been taken for some time, were successfully invoked by a number of learned and scientific societies in the financial stringency which followed on the War of 1914–18. It was a further manifestation of the favourable attitude of the authorities towards learning and research at this time, when not only was exemption from income tax allowed or continued to scientific societies which in addition to serving the interests of their members could be shown to be carrying out work of public utility, but also an additional concession made income tax recoverable on subscriptions guaranteed over a period of years.

It may seem that there has been a change in the spirit which prompted this last concession in Sir John Simon's statement last week that he is not prepared to propose an alteration of the law, which at present makes no provision for exempting benefits for research from estate duty. At the present time this decision is not surprising; but it is a matter which scientific bodies and organizations interested in research should not allow to go by default when a more favourable occasion arises. The trend of the application of financial legislation in the last hundred years has been to free the pursuit of learning from the burden of taxation so far as possible. In the days of financial stringency which the future will bring, estate duty will inevitably prove a heavy burden on posthumous endowment of research, unless a change is made.

Family Allowances

THE question of family allowances is discussed by a recent broadsheet issued by Political and Economic Planning (P E P), and in a new pamphlet by Miss E. F. Rathbone, "The Case for the Immediate Introduction of a System of Family Allowances and Alternative Proposals for such a System", issued by the Family Endowment Society, 72 Horseferry Road, London, S.W.1. The broadsheet points out that family allowances have become a live issue to-day for three main reasons: the need to restrict civilian consumption while safeguarding basic standards of health and nutrition; the claim for 'equal pay for equal work' which may arise sharply in the munitions industry if large-scale replacement of male by female labour occurs; and the need, intensified by new types of war-time distress and the multiplication of assistance scales, for codification of the numerous regulations. To relate income to the extent of family responsibilities is the only way of preventing the general reduction of consumption, however effected, pressing unfairly on large numbers of children. Wages are not only a payment for work done but also the means for rearing and maintaining a family, and all agencies by which consuming power is diverted from the social pool for the benefit of dependent wives or children are, in fact, agencies for family endowment. Miss Rathbone contends that family allowances offer the best means of meeting unavoidable increases in living costs simultaneously for workers in all occupations with similar family needs, without stimulating a race between prices and wages.

Both Miss Rathbone's review and the broadsheet discuss systems and experience in other countries, and favour a national service, State-regulated and State-administered. Tabular statements included in Miss Rathbone's pamphlet show that the charge on the Exchequer ranges from £118 million for a State-paid scheme, covering all children under fifteen years of age in Britain at 5*s*. per child, to £6½ million for the State share of a contributory insurance scheme, covering only the population insured for unemployment at 3*s*., beginning with the second child. Miss Rathbone prefers a bold imaginative scheme, covering the entire child population at the rate of 5*s*. a child, on the grounds of justice, for eugenic reasons and because of the greater simplicity of administration. If this is considered too costly, a contributory insurance scheme is urged involving an Exchequer contribution of £6½–£32½ million. Whatever the scheme, payment of the allowance to the mother is strongly recommended, partly to diminish the attraction of the labour market to married women and partly to emphasize that the allowance is not part of the remuneration of labour, but a recognition of the child's value to the community.

An International Air Force

A PLAN for the organization of an International Air Force is outlined in the report of the Military Research Committee of the New Commonwealth Institute, which was printed just before the outbreak of the War but has only now been issued. The scope of the proposed Force is as a reinforcement of the self-defence of States, adequate to give each the sense of security from attack that its unaided strength, alliances, or guarantees of neutrality are unable to ensure. The scheme could only operate if a sufficient number of States consented to cooperate, and the report points out that absolute neutrality is inconsistent with co-operation against war by any plan. Associated States would make an annual contribution to a common pool, in equal proportion to their total resources or war budgets. The assistance afforded to each assured State would be the maximum possible and not determined by the amount of its contribution. After discussing the advantages and disadvantages of the alternative systems of a Force composed of national quotas and an independent organic Force recruited by voluntary enlistment, the report strongly recommends the latter. It is essential, that the Force should be as efficient, as homogeneous, and as certain to act when required as is humanly possible.

In regard to language, the Committee recommends the adoption of Spanish, and it is suggested that each contributing State should provide a base with extra-territorial status in its territory for the Force, this distribution of bases giving a wide area of protection, while the Force should have the maximum possible freedom of movement both in peace and in war. In regard to the supply of aircraft, the Committee contemplates drawing on the manufacturing resources of private firms in all States sufficiently prominent in aviation, and manufacture would be directed and supervised by a design department, a research department and an inspection department serving the Force. The contributing States would be represented on the Board of Control, although the Force would have complete internal autonomy and the power of executive initiative. In addition to an intelligence service, the High Command would be provided with simple standing orders to ensure rapid action after determination of the facts. The scheme is regarded as well within the ability of European and adjacent States to finance, organize, equip and recruit.

Regional Organization and Local Government

IN a paper entitled "Regional Organization during and after the War" read before the Royal Society of Arts on February 7, Brigadier Sir Edward Tandy described the regional organization developed for defence purposes and discussed its adjustment to meet peace-time requirements after the War. Reviewing our existing peace-time machinery for local government, which he urged must be accepted but reinforced by regional organization to meet emergencies like that of war, Sir Edward Tandy suggested that the easiest way to establish the regional organization required for peace would be to accept the system established for war and retain a suitable nucleus of staff at each regional headquarters. These headquarters would be available almost at once to form advisory committees to consider how new measures of reconstruction could be best applied to each region, or the best distribution within each region of any funds which might be allotted by the central Government for particular purposes. They could also assist as liaison officers in smoothing difficulties between the central Government and local government authorities and the like, and Sir Edward suggested that the commissioners should be designated Commissioners of Public Welfare, to indicate the wide general scope of their activities. Such regional organization could easily be discarded if it proved to be superfluous, but Sir Edward indicated the difficulties which are at present continually arising in the absence of a regional system for peace-time purposes.

The Zoo during War-time

THE report of the Zoological Society of London presented at the annual meeting on April 29 shows that after the first great drop in public visitors last September to 11·3 per cent of the figures for the corresponding period of the previous year, there has been a healthy recovery. The Society is to continue its publications at about half the normal scale; 180 animals have been 'adopted' under the Society's war-time scheme to cover feeding costs and there have been developed photographic competitions to encourage amateur photography at the Zoo, and exhibitions of war-time utilities in food production in the way of goat, poultry, rabbit, pig, pigeon and bee keeping. A committee has been formed to revise the more obsolete of the by-laws, and the alterations will be put before the ordinary general meeting this month and balloted upon in August. Notable changes in staff have been the retirement of the curator of mammals and birds, and of the librarian, with temporary termination of the duties of the director of the aquarium (who is now working at the War Office), and of Mr. Bushby and Mr. Fisher.

British Museum (Natural History): Recent Acquisitions

THE Zoological Department has received from Mr. I. R. P. Heslop two skulls of the pigmy hippopotamus (*Chœropsis liberiensis*) which came from the Owerri and Warri Provinces in southern Nigeria. The interest in these two specimens lies in the fact that the distribution of this species was formerly held to be confined to a comparatively small part of West Africa, namely, to Sierra Leone, Liberia, and the French Ivory Coast. The Museum has received rumours from time to time during the past few years of the existence of the pigmy hippopotamus over a much greater range than was formerly thought to be the case. The occurrence of this species in southern Nigeria shows that its distributional area is very much greater than was assumed.

Major J. F. E. Bowring, of Ickingham Hall, Bury St. Edmunds, has presented to the Department of Mineralogy an exceptionally fine specimen of Burmese amber, probably the largest preserved in any museum. The specimen has a rich, dark brown colour, and is brightly fluorescent in ultra-violet light. It measures 22 in. × 14 in. × 7 in. and weighs 33 lb. 10 oz. The largest specimen of amber so far recorded is one weighing $21\frac{1}{2}$ lb., of lighter coloured Prussian amber, preserved in the Mineralogical Museum of the University of Berlin. The Department of Mineralogy has also acquired some crystals of pale green actinolite from Mogok, Burma. These are the first specimens of the amphibole family from that locality to be represented in the collections. The crystals are of gem quality, and, although they possess the good characteristic prismatic cleavage, the mineral more usually occurs in fibrous aggregates like tremolite asbestos.

Large-Scale Plankton Cultures

H. Pettersson, F. Gross and F. Koczy have published an account of large-scale plankton cultures using the plankton shaft of Pettersson's new institute (*Medd. Oceanogr. Inst., Göteborg*, No. 3; 1939). The shaft is cylindrical, 12 metres deep and 2 m. in diameter. Interaction between the concrete walls and the sea-water has been avoided by coating the latter with a British rubber composition 'Semtex', on which a cellulose white paint had been sprayed to lighten the dull grey. The tank was filled with a mixture of sea-water from the Bay of Biscay and fresh water, and was manured with nitrate, phosphate, silicate and filtered soil extract. The water was run in from the bottom after sterilization by passage over a mercury arc lamp. Layers of different salinity and temperature were formed, the temperature being kept down in the upper less saline layer by means of cooling coils. Illumination was supplied by sodium and mercury lamps and was usually maintained at 30–40 kilolux at the surface.

With a large crop of phyto-plankton or flagellates in the water the light intensity was reduced to 50 per cent in a depth of rather less than a metre, and at the lower limit of the culture medium layer, 550 cm. thick, the light had fallen to the level of the compensation intensity, about 500 lux. Samples of phytoplankton and zooplankton from the Swedish coast were introduced into the upper layer, which was usually at 7°–9° C. Good growth was obtained and observations were made upon the vertical distribution of the animals as a phototropic response. Quantitative measurements were made at intervals of the changes in the diatoms, autotrophic flagellates and copepods. Thus the first steps have been taken in the development of a valuable method for the study of plankton in an immobilized water column in which the physical and chemical conditions can be varied at will. An observational is thus transformed into an experimental science.

Phenology of 1939

THE Royal Meteorological Society's Phenological Report for 1939 has been issued with its usual abundance of statistics and diagrams (Roy. Meteor. Soc., London. 3*s*.) It is interesting to note that the work is to continue, despite the War, and that other organizations like the British Empire Naturalists' Association and the Rothamsted Experimental Station are co-operating. There is a total of 385 observing stations compared with 439 in the previous report, and a scheme has been prepared to meet the growing demand for a simple method of assessing and demonstrating, at intervals throughout the year, the state of the season in the British Isles, making use of the Society's organization. In order to replace some unsatisfactory plants on the list, flowering dates are being made for the first time of *Cardamine pratensis*, *Acer pseudoplatanus*, *Viburnum opulus*, *Digitalis purpurea* and *Calluna vulgaris*. The historic phenological observations at the Marsham district of Norfolk, which have been made since 1736, are being continued.

With regard to meteorological effects in Great Britain during 1939, the severe December-January cold did not affect plant-life generally; the subsequent warm spells produced forwardness with a tendency to persist, especially with regard to insects, the larvæ of which experienced early favourable conditions for feeding up after hibernation. The general influence of the year, so free from extremes, was favourable to fruit, cereal and root crops (in striking contrast to the previous year), and wild fruits were also plentiful; absence of severe gales and early frosts resulted in brilliant autumn tints and the second flowering of many plants. Spring bird migrants generally tended to lateness in arrival. Of migrant insects, *Vanessa cardui* appeared in considerable numbers, but the weather was unsuitable for the larvæ to produce many autumn specimens. *V. atalanta* and *Colia croceus* were scarce, but striking immigrations of *Pieris rapæ* and *P. brassicæ* from all parts caused great damage to greens. Generic names in full have now been added to the index table and nomenclature is brought up to date. The promptness of the appearance of the report under the difficulties of present conditions is most encouraging to all the voluntary workers concerned.

Australian Aboriginal Artist

ILLUSTRATIONS accompanying the printed report now available of a communication presented at the Canberra meeting of the Australian and New Zealand Association for the Advancement of Science which dealt with aboriginal sculpture render possible an independent judgment on material the discovery of which is hailed by the author, E. P. Goddard, as "one of the most noteworthy finds in many years" (*Report. 24th Meeting Aust. and N. Zealand Assoc. Adv. Sci.* 1939, Sect. F., Anthropology). The sculpture is the work of a woman of about thirty-two years of age, Kalboori Youngi by name, and a member of the Pitta-Pitta tribe. She is obviously a sculptor of natural genius, producing carved human figures remarkable both for their modelling and their detail, as well as their feeling for the disposal of mass and line. She works in two kinds of clays, of which one is used in the composition of the 'widow's caps' used in mourning rites. Her tool at first was a fine flake of quartzite, but she now employs a pocket-knife which has been given to her.

Although the Pitta-Pitta are now in contact with station-life, Youngi has not come under mission influence, nor has she seen sculpture of any kind. The Pitta-Pitta tribe is described as "virtually a tribe of hereditary artists", apparently on the ground that that part of the Diamantina of central western Queensland, more especially Brighton Downs station, contains numerous rock-drawings, paintings and carvings in caves and on rocks "executed long before the white man took up his pastoral holdings". The familiarity with graphic art may suggest the orientation of the aboriginal sculptor in seeking a form of self-expression, unusual and unexpected though it may be, but the derivation of the medium of expression, the sculptor's art, still seems obscure. The sculptures consist of human figures, male and female, singly and in groups, with horses and dogs as accessories rather than main elements in the composition in a manner which suggests the technique of European portraiture. The author compares this work with early Mesopotamian and Egyptian, but the comparison which suggests itself is with Sumerian, and notably the statue of Gudea.

Electrical Development in Ireland

FOLLOWING the reading by Mr. P. G. Murphy of a paper on "The Electricity System of Eire" at a meeting of the University College (Dublin) Engineering Society, Mr. Sean McEntee, Minister for Industry and Commerce, said that he agreed with the author's estimate that in normal circumstances the demand for electricity in Eire might be expected to double itself within a decade, so that the country would then be using about 800 million of electric units yearly. By interconnecting the electricity systems of Eire and Northern Ireland this was quite feasible. It did not necessarily follow that in normal circumstances the exchange of normal power would be very large, but the interconnexion would undoubtedly help to reduce the amount of stand-by plant to meet emergencies, and would enable provision to be made for security of supply at a far lower cost than could be made by either system independently. Perhaps this development may be hastened by the present abnormal situation.

From the experience of the Electricity Supply Board, a combination of water-driven stations and fuel-burning stations is essential in Eire. The Shannon scheme has reduced the dependence of Eire upon foreign fuel to about 220,000 tons of coal yearly. On the other hand, the Electricity Supply Board's accounts still shows that during the year ended March 31, 1939, £95,000 was spent on fuel, most of which was imported. Next to the Shannon and the Liffey, the Erne and the Boyne appear to be the most important rivers from a hydro-electric point of view. The Boyne might produce an additional 100 million kwh. per annum, but its development might be very unsatisfactory owing to high rates of compensation to landowners. The Erne, if satisfactorily developed, might give an annual output of 200 million kwh., but its storage facilities and a large part of its catchment area lie within the six counties of the north—a fact which has created a very difficult problem in drainage for the Government of Northern Ireland. Mr. McEntee believes it possible to develop the hydro-electric potentialities in such a way as to improve considerably the drainage in the area affected, but any such proposals would require the active co-operation of Northern Ireland and Eire.

Roads with a Cotton Fabric Basis

IN the United States of America there is a widespread interest at present in the new 'cotton roads' which are being made across the continent from New York to California and from Florida to Maine. According to an article published in *Roads and Road Construction* of April 1, the modern procedure in construction is to lay the cotton fabric on a surface treated with bituminous material. The bituminous material is then applied to the fabric and completely covered with crushed mineral aggregate. The crushed cover material is rolled in and a lighter application of bituminous material is applied and covered with a layer of chips, which are rolled in with a heavy roller. The best results in cotton roads have been obtained from cloth of comparatively open weave. The breaking strength varies between 25 and 45 lb. (grab method) according to grade. The most practicable fabrics cost between 450 and 750 dollars a mile for a road 18 ft. wide.

In New Jersey, cotton fabric and tar were applied on 600 linear ft. of a gravel road in South Brunswick township. After a year of service an inspection was made. Due to snow and light rain for two days the road and adjoining ground was saturated. On the part of the road where the fabric had not been used, the surface was broken in twelve places. Broken areas were 0·5–1·5 sq. ft. in area and were quite soft. In other places the surface was resilient and water would ooze to the surface under pressure with a blunt instrument. On the other hand, there were no broken places in the section which had been treated with cotton fabric, and the surface was tougher and less easily punctured with a screwdriver. Recent reports sent in from a number of highway departments indicate that short test sections of bituminous-surfaced roads, having cotton as part of their construction, have decreased maintenance costs and require less patching. The South Carolina Highway Department has used cotton fabric on bridge surfaces also with a marked degree of improvement in maintaining a satisfactory bituminous surface.

Progress in Stereo Plate Casting

A PAPER on stereo plate casting published in the *Electrical Review* of March 8 gives a survey of the progress made in the application of electric heating to autoplate machines for the production of stereo plates for rotary printing presses. For several years past much has been done in the United States, and pioneer work in England took place so long ago as 1930 at the *Daily Mail* offices in Manchester, where four electrically heated autoplate machines loaded at 120 kilowatts each represented, it is claimed, the first electric printing works foundry in Europe. The next major move was not until about a year ago, when Allied Newspapers Ltd. decided to electrify completely the autoplate installation at their Manchester offices.

The electric autoplates are fitted with baths each having a capacity of about 7½ tons of stereo metal, which, when casting is in progress, is kept molten at about 650° F. and at about 450° F. during stand-by periods. It takes about two minutes to raise the temperature from 450° to 650° F. The special immersion heaters are of grid construction, and in the largest machines have an installed heating load of 264 kw. This is probably the first time that metal-sheathed tubular heaters have been directly immersed in cast metal, and the result has been most efficient operation. Since the completion of the Allied Newspapers installation, electric heating has also been introduced at the foundries in Manchester of Odhams Press, Ltd., and the *Manchester Guardian*. In the later units there is automatic temperature control.

Carnegie Trust for Scottish Universities

THE latest report of the Carnegie Trust for the Universities of Scotland shows the varied and substantial aid given. The grants are arranged in quinquennial distributions, the seventh of which covers the years 1935–1940. An aggregate of £257,300 was allocated to the universities and extra-mural institutions. The Trust is generally associated with libraries and students' fees, but it also does a good deal for specialists engaged in scientific research, and it is satisfactory to read the good reports of their work, which is as wide as in former years, and maintains an excellent standard. Several of the fellows and scholars have secured places which render them independent of the Trust. The subjects studied range from the Atlantic grey seal in the Western Islands to protein metabolism and a new synthesis of compounds of therapeutic value. The Trust subscribes to the production of good books not likely to have a popular sale and to such enterprises as a further study of the Roman occupation of southern Scotland, aided by spotting from the air.

We notice in detail that in the Glasgow, Edinburgh, and Aberdeen centres agricultural colleges have received £200 a year each. St. Andrews has had £33,150 for alterations and extensions in the five years, and Glasgow, towards the cost of the new Chemistry Institute, £59,000. The Edinburgh accounts include £13,000 for a lecturer in English, also large sums for the endowment of prehistoric archæology and ethnology, while the Men's and Women's Unions are each put down for £3,000. Equipment for medical departments of the University comes to £7,250. Arrangements have been made to meet the difficulties caused by the War.

Chemical Research in Australia

THE Commonwealth Government has approved a further addition to the activities of the Council for Scientific and Industrial Research. A division of industrial chemistry is to be established with headquarters adjoining the recently erected Aeronautical Research Laboratory at Fisherman's Bend, Port Melbourne. £50,000 has been provided for the initial building and its equipment, and abundant space is available for later extensions. After prolonged discussions with leading industrialists, it has been decided to concentrate upon study of certain aspects of each of the following major lines : (1) non-metallic minerals and their utilization ; (2) metals and alloys, particularly from the point of view of corrosion ; (3) leather, hides and fellmongery ; (4) dairy products ; with (5) a miscellaneous group where work will begin on paints and varnishes. Dr. I. W. Wark has been appointed to control the work of the division.

Minerals of Canada

A USEFUL publication which has made its annual appearance is "The Canadian Mineral Industry in 1938" (Dept. of Mines and Resources, Mines and Geology Branch, No. 804. 25 cents). It gives the output of all important mines in Canada and the destination and use of the product. It is noteworthy that Canada, in its pitchblende deposit near the Great Bear Lake, shares with the Belgian Congo the source of nearly all the world's radium. The Canadian output has caused a considerable fall in the price of radium in recent years.

The International Seismological Summary

THE International Seismological Summary for January, February and March, 1934, has just been received. Apart from individual studies of earthquakes it gives the final determinations of the epicentres and starting times of all earthquakes sufficiently recorded at seismological observatories to make such determinations reasonable. The criterion has now been made "three consistent observations of P and S" to justify the determination. During the first quarter of 1934 there were 127 earthquakes whose epicentres were found; 47 of these were new and 80 were repetitions from old epicentres, showing the tendency of earthquakes to recur in any one place where an earthquake had once happened. All except six of the earthquakes had a normal depth of focus. The six exceptions were all of deep focus. The deepest recorded earthquake during the quarter was on January 18, 1934, with a depth of focus of 0·09 of the earth's radius, or about 360 miles. Its epicentre was lat. 22° S., long. 180°, which is in the Pacific Ocean to the south of the Fiji Islands, a well-established zone for deep-focus earthquakes.

Recent Earthquakes

THREE earthquakes of considerable severity have recently been recorded at European observatories, and a fourth has been experienced. The first was on April 13 and was recorded at De Bilt (Holland) at 6h. 34m. 56s. G.M.T. The epicentre was at a distance of rather more than 20° from De Bilt. The second was registered at De Bilt on April 16 at 6h. 19m. 30s. and at Kew at 6h. 19m. 33s. G.M.T. Dr. G. van Dyk considers that the epicentre of this shock was likely to have been in the region of the Aleutian Islands. It gave rise to ground amplitudes of 0·031 mm. at Kew. The third shock, which caused ground amplitudes of 0·05mm. at Kew, was registered there on April 16 at 6h. 54m. 53s. G.M.T. It also appears to have originated near the Aleutian Islands. The fourth earthquake was felt on the night of April 26 at Gropperia in Calabria, Italy. The same shock was felt at Soverto and Vivo Valentia, but no damage was done. Calabria has been the scene of intense seismic activity on numerous occasions in the past; but notably between February 5 and March 27, 1783, when 181 towns and villages were completely destroyed and more than 30,000 people killed. These Calabrian earthquakes were, according to Lyell, "the first example of a region visited, both during and after the convulsions, by men possessing sufficient leisure, zeal, and scientific information to enable them to collect and describe with accuracy such physical facts as throw light on geological questions".

Announcements

AFTER due consideration, it has been decided not to abandon the next meeting of the Australian and New Zealand Association for the Advancement of Science, which is due to be held in Adelaide in August. The meeting will, however, be shorter than usual and few of the normal social engagements will be included. The meeting is expected to commence on August 12 and end on August 16. The incoming president will be Dr. Patrick Marshall, testing officer in the Public Works Department, New Zealand, in succession to the late Sir Ernest Scott, whose death last year was a severe blow to the Association.

THE following officers of the North East Coast Institution of Engineers and Shipbuilders have recently been elected: *President*, Mr. W. A. Woodeson; *Vice-Presidents*, Mr. J. Ramsay Gebbie, Mr. N. M. Hunter and Mr. John Neill; *Hon. Treasurer*, Mr. W. H. Pilmour.

MESSRS. FREDERICK WARNE & CO., LTD., Chandos House, Bedford Court, Bedford Street, London, W.C.2, have published a leaflet giving advice on how to assist in saving the lives of wild birds around our coasts, which have landed in patches of oil and have become helpless. The leaflet can be obtained free of charge.

AN arrangement has been made between Messrs. Newton and Co., of 72 Wigmore Street, London, W.1, and Messrs. Newton and Co., Ltd., of 43 Museum Street, London, W.C.1, under which the two businesses, which until twenty years ago were one, will be amalgamated. The former manufacture optical lanterns, epidiascopes, projection microscopes and similar instruments, while the latter are well known as manufacturers of lantern slides and lantern filmstrip. The combined firms will carry on business under the style of Newton and Co., Ltd., and for a short time both branches will continue at their respective addresses, after which the whole business will be transferred to the Museum Street address.

THE Coopers Hill War Memorial Prize and Medal, which was founded by members of the Royal Indian Engineering College, Coopers Hill, in commemoration of members of the College who fell during the War of 1914–18, is awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. The prize consists of (*a*) a bronze medal, (*b*) a parchment certificate of award, and (*c*) a money prize of the value of about £20. The triennial award falls this year to the Institution of Electrical Engineers, which has decided to invite members to submit for consideration a paper on any subject coming within the scope of electrical science or electrical engineering and their applications. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

DR. K. R. POPPER has pointed out a misprint in his letter "Interpretation of Nebular Red-Shifts" published in NATURE of January 13, p. 69. Formula (1) should read: "$(d\lambda/\lambda)_{T+\Delta T} = (\Delta c_T/T)_{T+\Delta T}$". Formula (7) is not very clear as printed; it should read: "$\nu_\tau = \nu_P dT_\tau/d\tau = \nu_P e^{\tau/T_P}$".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 709. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Colloidal Electrolytes

COLLOIDAL electrolytes are among the commonest of substances, probably more numerous than acids and bases. I have defined this class as electrolytes in which at least one of the ions is replaced by colloidal particles[1]. Examples are the family of soaps and the closely related sulphated compounds and the modern synthetic detergents, the bile salts, the dyes, biocolloids and many others. For no one of these solutions have we complete physical chemical information, and the various members show such characteristic differences that the following general statements serve only as a guide.

I based my conclusions that colloidal electrolytes exist upon osmotic or thermodynamic data, which were far lower than corresponded to electrical conductivity. Hence much of the latter had to be ascribed to colloidal ions. The details were naturally interpreted in terms of the then prevailing doctrine that all electrolytes were only partially dissociated.

Lottermoser[2], in 1933, showed that in extremely dilute solution alkyl sulphates followed the behaviour of completely dissociated ions. Hartley[3], in 1936, showed by transport measurements that the rather abrupt departure from this simple behaviour is accompanied by a corresponding change in transport number which occurs over a ten-fold range in concentration, and must definitely be ascribed to formation of colloid. Hartley, as I did at first, attempted to get along with only one form of colloid, but I found that this could not be reconciled with the quantitative data for conductivity, transport, and freezing point simultaneously. Hartley's further evaluation of transport numbers as "conductivities" has misled many subsequent readers. My lamellar colloid was unhappily named "neutral" to contrast it with the small, more spherical, highly charged and highly mobile ionic micelles. M. E. Laing McBain[4] showed, in 1926 and in 1935, that the lamellar micelle conducted as well as crystallized soap curd fibres; that is, about 7 per cent as well as an equivalent concentration of sodium chloride. Her diffusion data[5] give striking support to the presence of both ionic and lamellar micelles.

The existence of lamellar micelles has recently been demonstrated beyond peradventure by X-ray measurements, especially those of the collaborators of Hess and of Thiessen[6]. Stauff finds them to be *liquid* crystals consisting of double sheets of molecules in parallel array. Stauff's "*Grossmizellen*" are identical with my "neutral" or lamellar micelles. Thus it is definitely settled that there are two kinds of colloidal particles in, for example, soap solution.

Stauff[6], Hess[6] and Hartley[7] have each recently summarized the views of their respective groups. The chief remaining divergence of opinion is as to the Debye-Hückel effect of a conducting colloid particle. Hartley maintains that it has the activity and ionic effects of a highly multivalent ion. This, as Hartley shows, should effect an enormous lowering of thermodynamic activity as well as conductivity, even in great dilution. Van Rysselberghe[8] and I prefer to suggest that the charges are so far apart (16 A. according to Hartley) that their influence is as little as in solutions of uni-univalent electrolytes. This view accords with the fact that admixed electrolytes produce an additional lowering of freezing point or increase of conductivity or an electromotive force about the same as if they had been dissolved in pure water as solvent.

Meyer and van der Wyk[9] have shown how with simple assumptions it is possible to build up extensive lamellar micelles by equal steps beginning with the simplest aggregates, namely, ion-pairs, so that a proportion of all sizes will be simultaneously present. This appears especially evident when examining the freezing point and other data for the lower members of the homologous series where ion-pairs become appreciable. After a certain size, further growth of lamellar colloid has but little influence upon the properties of the solutions.

A most important and unexpected property of many colloidal electrolytes is their detergent action. For example, a dilute soap solution dissolves appreciable amounts of hexane, lowering its vapour pressure to a value far below that of free hexane. Bile salts exhibit this property of dissolving otherwise insoluble materials, essential to physiological function. Hess has shown that the X-ray spacings of the lamellar micelles expand to incorporate sheets of the hydrocarbon just as they normally contain sheets of water. Such detergent action is noticeable at concentrations far below those at which lamellar micelles are shown by X-rays and even below the critical concentration of ion association. The amounts taken up bear in general no relations to the chemical nature of detergent and substance dissolved or to ordinary solubilities.

Finally, most colloidal electrolytes, like their non-electrolytic relatives, are highly surface active. Many exhibit remarkable anomalies in surface behaviour, in some cases at a concentration below that at which micelles are recognized to form, and in others in a higher range of concentration.

I am of the opinion that in accordance with the mass law the ionic micelles begin to form in very dilute solution and steadily increase throughout parallel to the thermodynamic necessity that the concentration of simple ions likewise must increase throughout the range of stable solution. The lamellar micelles arise from ion-pairs and higher aggregates formed at the "critical concentration for micelles", increasing in size and amount until their development is sufficient to produce an X-ray pattern in the solution.

J. W. McBain.

Stanford University,
California.
March 23.

[1] McBain and collaborators, *J. Chem. Soc.*, **101**, 2042 (1912) ; **105**, 417, 957 (1914) ; **113**, 825 (1918) ; *J. Amer. Chem. Soc.*, **42**, 426 (1920) ; *Proc. Roy. Soc.*, A, **97**, 44 (1920).

[2] Lottermoser *et al.*, *Kolloid Z.*, **63**, 175 (1933) ; *Kolloid Beihefte*, **45**, 253–412 (1937).

[3] Hartley, Collie and Samis, *Trans. Faraday Soc.*, **32**, 795 (1936).

[4] M. E. Laing McBain, *J. Phys. Chem.*, **28**, 673 (1924) ; *Trans. Faraday Soc.*, **31**, 153 (1935).

[5] M. E. Laing McBain, *Proc. Roy. Soc.*, A, **170**, 415 (1939) ; *J. Amer. Chem. Soc.*, **61**, 3210 (1939).

[6] Krishnamurti, *Indian J. Phys.*, **3**, 307 (1929) ; Hess *et al.*, *Ber.*, **70**, 1808 (1937) ; *Naturwiss.*, **27**, 593 (1939) ; *Kolloid Z.*, **88**, 40 (1939) ; Thiessen, Stauff *et al.*, *Naturwiss*, **27**, 213 (1939) ; *Kolloid Z.*, **89**, 224 (1939). Cf. McBain's diagram, *J. Chem. Educ.*, **6**, 2121 (1929).

[7] Hartley, *Kolloid Z.*, **88**, 22 (1939).

[8] Van Rysselberghe, *J. Phys. Chem.*, **43**, 1048 (1939).

[9] Meyer and van der Wyk, *Helv. chim. Acta*, **20**, 1321 (1937).

Cosmic Ray Intensities and Cyclones

In a recent note[1], we have pointed out that cosmic ray intensities in Japan show a noticeable change under different air mass conditions. In this letter we should like to direct attention to the effect of cyclones on cosmic ray intensities.

The cyclonic structure, after the Norwegian school, is shown in Fig. 1, where solid lines represent isobars. The right-hand discontinuity of the cyclone becomes a warm front, where the warm tropical air is forced to override the cold wedge of air underlying it. The left-hand portion of the cyclone becomes the cold front, where the head of cold air is displacing the warm air. In normal cases the cold front travels faster, so that it soon begins to overtake the warm front, resulting in an occlusion. In Japan proper, the air behind the cold front is generally colder than that ahead of the warm front, having had a shorter trajectory over relatively warm sea areas.

In order to see the influence of cyclones on cosmic rays, the following procedure is adopted. We choose for the present purpose thirteen typical cases of developed cyclones during the year 1937, the centres of which were determinable within a radius of about 1,100 km. (or 10° latitude) from Tokyo. Corresponding hourly means of cosmic ray intensity, 359 in number, are picked out from the data obtained with a Steinke cosmic ray meter inside 10 cm. of lead. The observed intensities are then reduced to the values at the standard pressure 755 mm. mercury using a true absorption coefficient $\mu = 9 \cdot 5 \times 10^{-3}$ cm. mercury for air.

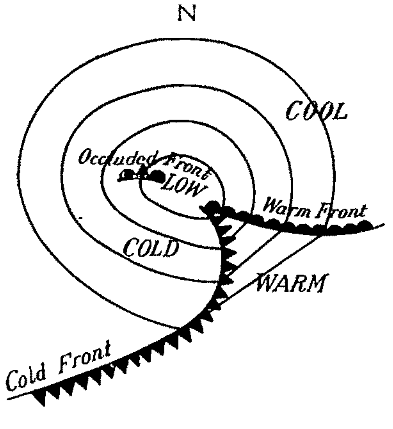


Fig. 1.

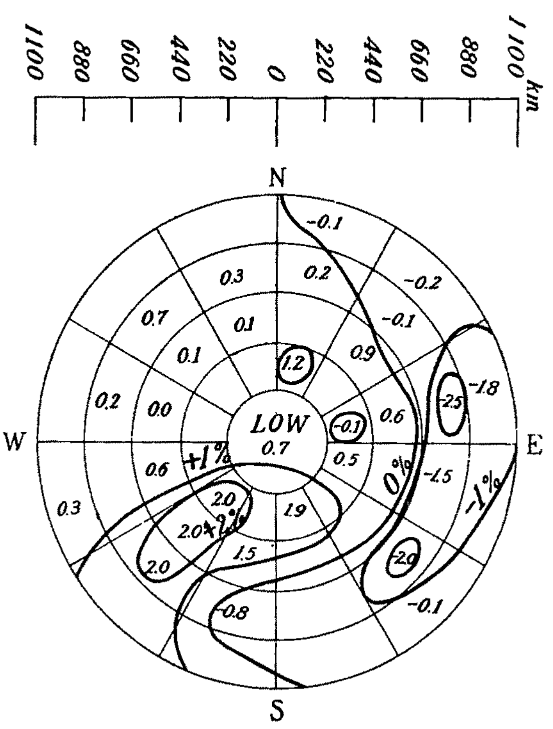


Fig. 2.

Taking the centre of the depression as the origin, we now consider the position of Tokyo relative to it, representing it on a polar diagram which is divided into 49 sections (Fig. 2). Cosmic ray intensities in Tokyo at its various relative positions from the cyclonic centre are then written down on the corresponding sections of the diagram and the average intensity is determined for each section. Fig. 2 shows the percentage difference thus obtained of each average from the mean of the total.

The diagram shows, as a general feature, that the intensity of cosmic rays is highest when Tokyo lies to the south-west, lowest when it is to the east-south-east, and intermediate when it is to the north-west of the cyclonic centre. This means, from Fig. 1, that the passage of a cold air mass tends to increase the cosmic ray intensity, while that of a warm air mass tends to decrease it. Variations of exactly the same character have been shown in our recent note[1] to take place under various air mass conditions of the year, the effect in both cases being of about the same magnitude, ±2 per cent.

Since we find low values of cosmic ray intensities in the warm-front face and high values in the cold rear as shown in Fig. 2, we can deduce the presence of active warm air overriding the thin cold wedge of air far out into the cool sector and extending high up to the upper troposphere or even to the stratosphere. It is interesting to note that cosmic ray data provide us with knowledge on the upper air conditions rather than those of the lower atmosphere.

The explanation of these results on the basis of the instability of the meson will be given elsewhere.

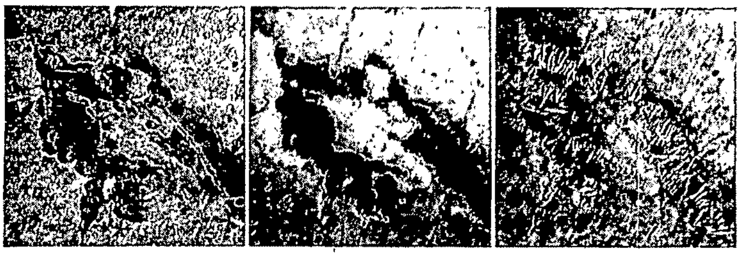
This work was done as a part of the programme of the Cosmic Ray Sub-Committee of the Japan Society for the Promotion of Scientific Research.

Y. Nishina.
Y. Sekido.
H. Simamura.
Institute of Physical and Chemical Research,
Tokyo.
H. Arakawa.
Central Meteorological Observatory,
Tokyo.
Feb. 24.

[1] Nishina, Y., Arakawa, H., Sekido, Y., and Simamura, H., *Phys. Rev.*, in the press.

A Lead Etching Effect

The observations described below have been made in the course of the metallographical examination of some samples of ancient lead of Roman origin (*ca.* second century A.D.). These leads, hailing from Corbridge, Northumberland, and Pentre Ffwrndan, Flintshire, appear to have been left in the furnaces in which they were produced, and were evidently, at the end of furnace operations, in an oxidized condition, for they now contain patches of red litharge, which occupy blow-holes and rifts in the metal. This litharge has been isolated and its identity proved by tests and also analytically, two preparations from different sources being found to contain 95·6 and 97·7 per cent of PbO, the balance being mainly infiltrated carbonates of iron and calcium.



Micrographs of lead containing inclusions of litharge (× 25).

For etching sections of these samples, an extremely dilute solution of hydrochloric acid, at the boiling temperature, proved satisfactory, since its attack on the litharge is limited and, at the same time, the surface of the lead is cleansed by it. A striking result of this mode of operating is that the lead in contact with litharge, whether embedded in it, or surrounding an inclusion of the oxide, becomes fringed with dendrites of lead. This is illustrated in the accompanying micrographs (× 25), *A* being that of a polished surface of lead, with inclusion of litharge, *B* and *C* the same area after immersion in the etching medium for 10 and 30 seconds respectively.

At first sight, these appearances suggest that a pre-existing relationship of the two constituents, such as would arise from the solidification of the metal in a fluid lithargic medium, had been unmasked by etching; but this is obviously impossible since the freezing point of the litharge is about 600° C. above that of lead. Further, the perfection of the dendritic forms at various stages of development should be noted, which suggests continuous growth of the lead crystals during the etching process.

Such considerations led to the conclusion that the phenomenon resulted from chemical changes taking place during the etching process; and it happens that my attention had already been directed, by other observations in this field, to the fact that when lead and litharge are placed in contact, covered with water, and the water slightly acidified with one of the common acids (hydrochloric, nitric, acetic), a lead-tree is formed, the deposition of the lead being sometimes in the form of delicate dendrites, sometimes in compact masses of equiaxial crystals, among which well-shaped cubo-octahedrons can occasionally be discerned. The appearances shown by these ancient leads can be imitated perfectly by binding together a piece of sheet lead with a tablet of litharge (either cut from the massive material, or made by compressing the powder), or even with a plate of tabular cerussite, then cutting a cross-section through the two and etching in the manner described above.

These reactions are obviously related to those which have been observed on the precipitation of lead from solutions of its salts by lead itself, which result in the formation of what has been termed an autogenous lead-tree. Nearly a century ago, Wöhler[1] observed this to happen when a rod of lead was immersed in a concentrated solution either of nitrate or acetate of lead over which water was poured carefully, so that the liquids did not become mixed; precipitation then occurs on the part of the metal in the concentrated solution. There can be little doubt that the explanation of the etching effect described here is to be sought in a similar difference of concentration of the lead solution produced by the action of the etching acid on the litharge. It is remarkable that the action should be so speedy and should take place even when the specimen is held in an inverted position and moved continually to and fro.

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[1] Wöhler, F., *Ann. Chem.*, 83, 253 (1853).

Congenital Hyperglycæmia in Mice

Cammidge and Howard[1] have published some very remarkable results concerning the genetics of hyperglycæmia in mice. They state that their mice fell into two groups. In one of them the concentration of blood glucose, estimated by Folin and Wu's method, lay between 124 and 114 mgm. per 100 ml. In the other it lay between 88 and 74. The hyperglycæmic condition behaved as a recessive, and was not linked with albinism.

The accompanying table shows the striking fact that in each of the seven families which segregated, the observed figures agreed with the expectation to the nearest unit. The expectations in each column are given in italics immediately after the observed

Family	Coloured normal	White normal	Coloured hyper-glycæmic	White hyper-glycæmic	Probability
B	6, *5·5*	5, *5·5*	—	—	0·4512
E	—	17, *17·5*	—	18, *17·5*	0·2641
F	8, *7·75*	8, *7·75*	7, *7·75*	8, *7·75*	0·02159
G	6, *5·75*	6, *5·75*	6, *5·75*	5, *5·75*	0·03281
H	26, *26·44*	9, *8·81*	9, *8·81*	3, *2·94*	0·005179
J	18, *18*	6, *6*	6, *6*	2, *2*	0·009292
K	16, *16·9*	6, *5·6*	6, *5·6*	2, *1·9*	0·03472

results. The last column gives the probability of obtaining so good a result. As an example of the calculation, the following observations would have given as good a fit or a better one in the case of family *K*: 16, 6, 6, 2; 17, 6, 6, 1; 17, 6, 5, 2; 17, 5, 6, 2. Since the expectations are $\frac{9}{16}$, $\frac{3}{16}$, $\frac{3}{16}$ and $\frac{1}{16}$ of the total of 30, the respective probabilities are:

$$\frac{30!\,3^{44}}{16!\,6!\,6!\,2!\,16^{30}},\quad \frac{30!\,3^{46}}{17!\,6!\,6!\,1!\,16^{30}},\ \text{and}\ \frac{30!\,3^{45}}{17!\,6!\,5!\,2!\,16^{30}}$$

in the last two cases. The sum of these is 0·03472.

In all cases except the last, the fit was as good as possible. We are therefore justified in multiplying the probabilities together, and find that, for the first six families, the probability of obtaining the best possible fit is $4{\cdot}06 \times 10^{-9}$. We cannot make an estimate of the joint probability of so good a fit for all seven families without using a criterion such as χ^2, which is not wholly suitable in such cases. But it is clear that Cammidge and Howard's results cannot reasonably be explained on a basis of random sampling.

Other workers on mouse genetics, even when their totals agreed very well with expectation, have always observed a considerable amount of divergence in individual families, which was sometimes greater than that to be expected on a basis of random sampling, and never much less. The results obtained by Cammidge and Howard[2] in the case of congenital hypoglycæmia are not quite so striking, but they too are difficult to explain on the basis of sampling theory. Both sets of data would be fully explicable had the authors selected for publication out of a much larger number those data for which the agreement between theory and observation was closest. We therefore consider that, as in the case of Moewus' results, discussed by Philip and Haldane[3], those of Cammidge and Howard should not be accepted until they have been confirmed by other workers.

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April 10.

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[1] Cammidge, P. J., and Howard, H. A. H., "Hyperglycæmia as a Recessive Character in Mice", *J. Genet.*, **16**, 387–392 (1926).

[2] Cammidge, P. J., and Howard, H. A. H., "The Hereditary Transmission of Hypoglycæmia in Mice", *Proc. Roy. Soc. Med.*, **23**, 1341–1343 (1930).

[3] Philip, U., and Haldane, J. B. S., "Relative Sexuality in Unicellular Algæ", NATURE, **143**, 334 (1939).

True and False Teleology

THERE has recently been a considerable revival of interest, largely due to the work of Darlington[1], in the teleology of different systems of reproduction. The logical status of teleological arguments is very different in this connexion from that in other spheres, since the 'purpose' which is brought forward is the fulfilment of the conditions for rapid evolutionary advance under the influence of natural selection. That is to say, a genetic system which achieves its 'purpose' provides in so doing the mechanism for its survival. The considerations which have led to the rejection of teleological arguments in other connexions therefore do not apply; though one might still question whether the teleological phraseology is the most convincing in which the arguments can be framed.

There is, however, a danger that the teleological method of argument will be carried over, by association, into regions in which it cannot be sustained. This seems to have occurred, to some extent, in the valuable article by Mather[2] in which he discusses the evolutionary significance of the formation of two different sexes in the diploid phase. He is not content to point out that the separation of the sexes is a mechanism for encouraging cross-breeding, but he contrasts this statement with some sentences, taken from a recent work of mine[3], on the developmental mechanisms involved, from which he deduces that "the sexes are separated supposedly in order to ensure that the gametes are differentiated". Such a view, he states later, must be rejected.

But such teleological statements should never arise in a discussion of developmental mechanisms. It is not sufficient to recognize that the development of two distinct sexes may be an evolutionary advantage; we have still to find out how it is done, and the "developmental-genetical idea" cannot be "dismissed". At the same time, this does not invalidate the arguments which Mather brings forward as to the evolutionary consequences of such a differentiation; in fact, he will find a statement of his main point, that the evolutionary advantage of having two distinct sexes is that it ensures cross-breeding, in the sentence immediately preceding the ones he chooses to quote. But if the new teleology is to be received with the respect which is its due, it is of the greatest importance that it should not stray outside its own legitimate fields.

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April 1.

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[1] Darlington, C. D., "The Evolution of Genetic Systems". (Cambridge: University Press, 1939.)

[2] Mather, K., NATURE, **145**, 484 (1940).

[3] Waddington, C. H., "An Introduction to Modern Genetics". (London: Allen & Unwin, 1939.)

DR. WADDINGTON's criticisms seem to be two. In the first place, I am taken to task for the unwarrantable use of teleological expressions, particularly in the specific case of my paraphrase of his own discussion of sex separation. Inasmuch, however, as the discussion was originally Waddington's and not mine, I can scarcely be called to account for its nature, whether teleological or otherwise. In any event, the point is trivial, as I feel confident that Darlington and Waddington would agree with me in regarding adaptation as the outcome of selection and in denying that it was purposeful, whether the discussion concerned genetical or morphological questions.

Secondly, I am criticized for wishing to "dismiss" the "developmental-genetical idea". This I have no desire to do in general as, clearly, developmental studies can contribute much to our understanding of genetics. But I do disagree with the specific idea, apparently held by Waddington in common with many others, that separation of the sexes in the diploid phase is essentially a reflection of gametic differentiation. They may be related developmentally in diœcious organisms, but this should not blind us to their wholly dissimilar genetical consequences. Gametic differentiation cannot of itself lead to regular outbreeding, as is well shown by Triticum and Pisum, where the two kinds of gametes are strikingly different but where self-fertilization is the rule. On the other hand, crossing between different individuals must always follow from diœcism. As Waddington, in the section of his book which I quoted, and in the previous sentence which I did not quote, relates outbreeding primarily to gametic differentiation and thence secondarily to separation of the sexes, I must disagree with him. Differentiation of the gametes has no place in the genetical relation between outbreeding and unisexuality.

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Moisture-Relation as a Determining Factor in the Transformation of the Basidia of Certain Polyporaceæ

BASIDIA of many Polyporaceæ at the end of the rainy season and during intervals between two showers of rain have been observed to be gradually transformed into hyphal elongations with terminal spores that are exactly like basidiospores. Conversely, on the advent of rain in the middle of a dry season, the hyphal elongations soon become reconverted into regular basidia.

Such conversion has been reproduced under experimental conditions. When a piece of the fruit body of a thin and desiccated specimen was placed under the running water of a laboratory tap overnight, the hyphal elongations entirely disappeared from the pore-tubes and the majority of the pore-tubes developed mature basidia with sterigmata and spores. When a piece of the same fruit-body was stuck to the lid of a moist agar-plate and examined daily under the microscope, it was found that, as the water of condensation gradually disappeared from the plate in the course of three or four days and the plate became comparatively dry (the relative humidity becoming reduced to about 85 per cent), the pore-tubes displayed a development of a large number of clamped and elongated hyphæ with terminal spores and a few abnormal elongated narrower basidia. The experiment was repeated several times and sometimes in reverse order, and in each case the same result was obtained. Such experimental conversion was quite successful with thin and easily desiccated specimens of Polyporus, Polystictus, and Hexagonia. It did not succeed well with very thick specimens of Polyporus, Dædalea, Fomes, Trametes, Lenzites, etc., as it is known that all specimens cannot withstand desiccation to the same degree.

From the experiments described above it is concluded that it is mainly the water-relation which controls the transformation of basidia into hyphal elongations with clamp-connexions and terminal spores and *vice versa*. None of the previous workers (Patouillard, Matruchot, and Heim) has correlated this change of form of basidia with the varying external conditions.

Details of the work will be published elsewhere.

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March 20.

Urinary Excretion of Combined Ascorbic Acid in Pulmonary Tuberculosis

IT has been shown before[1] that several plant tissues contain ascorbic acid in a combined state (ascorbigen) besides free ascorbic acid. This substance has since been considerably concentrated from cabbage[2]. The presence of combined ascorbic acid in urine was observed by Scarborough and Stewart[3] and by ourselves[4]. Evidence has been presented from this laboratory[5] which indicates that ascorbic acid may have a detoxicating action both in the normal system and also in the infected condition. Thus after the injection of diphtheria and tetanus toxins into guinea pigs, excretion of free ascorbic acid in the urine was found to be diminished, associated with an increase in the output of combined ascorbic acid. Abbasy, Hill and Harris[6] also showed that in certain infected conditions the excretion of free ascorbic acid was decreased, but the fate of the disappearing ascorbic acid is unknown. We have recently been able to investigate the relative excretion of free ascorbic acid, dehydro-ascorbic acid and combined ascorbic acid of nine normal individuals and of sixteen patients suffering from acute pulmonary tuberculosis. The mean values are given below and are expressed in terms of ascorbic acid (mgm.) excreted during a 24-hour period.

	Free ascorbic acid	Dehydro-ascorbic acid	Combined ascorbic acid	Total ascorbic acid	Combined ascorbic acid as percentage of the total
Tuberculous	5·82	3·52	8·11	17·45	42·24
Normal	44·62	7·41	15·93	67·96	23·82

A statistical analysis of the detailed individual figures, kindly carried out by Mr. K. C. Basak, gave the following results :

Difference of mean rates = 18·42
Standard error of difference = 7·56
t = 2·44

The probability of obtaining such values of t by chance alone is less than five in a hundred. The proportion of combined ascorbic acid excreted is therefore significantly higher in tuberculous patients than in normal healthy individuals.

From these results it appears first that there is a large reduction in the urinary output of total ascorbic acid in tuberculosis, and secondly that in tuberculosis there is a tendency to a relatively greater excretion of combined ascorbic acid. Apart from the simple destruction of ascorbic acid in the infected condition owing to increased metabolism, this evidence appears to support the view that ascorbic acid probably functions as a detoxicating agent, combines with certain toxins or toxic metabolites produced in the infected condition and tries to eliminate them.

Our thanks are due to Dr. B. K. Paul and his staff of the National Infirmary, Calcutta, for the facilities provided for this work.

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P. B. Sen.
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March 27.

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[1] Guha and Paul, Nature, 137, 946 (1936); 139, 844 (1937).
[2] Ghosh and Guha, *J. Indian Chem. Soc.*, 16, 505 (1939).
[3] Scarborough and Stewart, *Biochem. J.*, 31, 2231 (1937).
[4] Guha and Sen-Gupta, Nature, 141, 974 (1938).
[5] Ghosh, *J. Indian Chem. Soc.*, 16, 241 (1939); 16, 657 (1939).
[6] Abbasy, Hill and Harris, *Lancet*, ii, 1413 (1936).

Economic Importance of the Australian Ant, *Chalcoponera metallica*

While in Queensland during the southern winter of 1939, I took advantage of an opportunity to observe the daily activity at a number of nests of the Greenhead ant, *Chalcoponera metallica*. An analysis of the data obtained in regard to the feeding habits of this species would seem to indicate that, in southern Queensland at least, it is of very considerable economic value.

The Greenhead is a small species, the worker measuring only *circa* 8·5 mm. The colonies also are small, and are very simply organized, the nests taking the form usually of a number of irregular galleries excavated in the earth about grass-roots, or under a stone or log. The species is notable for the remarkably severe sting it can inflict, considering its small size. Observation shows that Chalcoponera is almost exclusively insectivorous like most of the Ponerinæ; the animals upon which it preys prove to be for the greater part agricultural pests. It is a significant fact that these latter are deliberately attacked and killed by Chalcoponera, several ants combining in the attack when the victim is large. In Table 1, set out below, are given the percentages by weight of the chief classes of food, the figures being the average for three colonies.

Table 1.

Larvæ. (Lepidoptera, Coleoptera, Diptera)	77·5%
Small Arachnids	11·2%
Microlepidoptera (adults)	6·8%
Other Insects (Termites, Diptera, Ants, Ichneumons, etc.)	4·5%

If the actual numbers of the insects preyed upon be tabulated, a rather different order of importance is seen, but larvæ still occupy the first place. Table 2 shows the average collection of a single colony during a working day of eleven hours.

Table 2.

Larvæ	125 per day
Small Arachnids	22 ,, ,,
Termites	16 ,, ,,
Dipterous flies	14 ,, ,,
Microlepidoptera	7 ,, ,,
Ichneumons	6 ,, ,,
Red Ants	5 ,, ,,

It is evident from the foregoing that plant-destroying insects, particularly larvæ of Lepidoptera and Coleoptera, form the bulk of the diet of this species. As these figures were obtained during the winter months they are likely to indicate a minimum rather than an average for the year as a whole; but calculation even from these winter figures shows that Chalcoponera must do an immense amount of good in the active destruction of grubs, whatever other damage to roots may be caused by the ants themselves. If these observations are typical, it would appear that a single colony of Chalcoponera, numbering only a few hundred individuals, will destroy more than 45,000 grubs in a year.

Wheeler has already pointed out that "the economic value of the Ponerinæ in tropical countries can hardly be over-estimated", largely on account of their destruction of termites[1]. He regards specialization in other insect food as exceptional in the group, citing in Africa *Platythyræa arnoldi*, which feeds mainly on small beetles, and *Plectroctena mandibularis* on millipedes and beetles[1], and in America *Lobopelta elongata* on isopods[2]. *Chalcoponera metallica* must now be added as an Australian example of this exceptional specialization.

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April 2.

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[1] Wheeler, W. M., *Bull. Amer. Mus. Nat. Hist.*, 45, 57 (1922).
[2] Wheeler, W. M., "Ants, their Structure, Development and Behaviour", 233 (New York, 1910).

Sulphanilamide and Glucose Antidote

The production of methæmoglobin in the blood by oxidation of hæmoglobin by sulphanilamide has been discussed by Shaffer[1], Locke and Mellon[2] and Mayer[3]. Locke and Mellon attribute the oxidizing action to the *p*-nitroso benzene sulphonamide and not to the hydroxylamine derivative. They further state that the hydroxylamine derivative is not an oxidizing agent at the *p*H of the blood, and believe that the chemotherapeutic action is due to its power of inactivating catalase (Sevag and Maiweg[4]).

In cases where there is severe oxygen-want, by the production of too much methæmoglobin and subsequent danger of damage to tissues or death, attention is directed to the fact that intravenous injection of isotonic glucose solutions immediately reduce methæmoglobin to hæmoglobin (Brooks[5]), thereby permitting the blood to carry oxygen again, and relieving the symptoms. In the case of methæmoglobin formation by sulphapyridine, the same therapy is indicated.

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Berkeley.
April 5.

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[1] Shaffer, P. A., *Science*, 89, 547 (1939).
[2] Locke, A., and Mellon, R. R., *Science*, 90, 231 (1939).
[3] Mayer, R. L., *Bull. l'Acad. Méd.*, 117, 727 (1937).
[4] Sevag, M. G., and Maiweg, L., *Biochem. Z.*, 288, 41 (1936).
[5] Brooks, M. M., *Proc. Soc. Exp. Biol. Med.*, 32, 63 (1934); *Calif. and Western Med.*, 41, 131 (1934); 43, 327 (1935).

Effect of the Severe Frost of the Winter of 1939-40 on the Fauna of the Essex Oyster Beds

The severe frost in the winter of 1939–40, some details of which were recorded in Nature (145, 376; 1940), caused great destruction of oysters on the Thames Estuary oyster beds. Temperature readings in the Blackwater showed that the water reached 0° C. on January 1, and remained at about this level until February 19. Ice began to form on January 17, eventually forming floes which persisted for a month. Thick ice blocks were formed earlier in the shallow water of Whitstable (see accompanying illustration).

In a recent inspection (February) of the oyster beds on the Rivers Blackwater and Roach some indication has been obtained of the high rate of mortality of oysters (*O. edulis*) to date.

The entire stocks of imported Brittany oysters, all of saleable size, have been virtually lost. Sample dredgings on nine different grounds yielded in all 5,920 Brittany oysters, of which only 206 (3·5 per cent) were alive. A high percentage had died recently, as was shown by the presence of flesh in the gaping valves; in a sample count of 202 dead, 137 (68 per cent) retained dead flesh. Of those still living most were in the hockly condition, that is, not able to keep the valves tightly closed; a large number contained mud, apparently accumulated from a more or less permanent gape. A sample of 27 hockley Brittany oysters dredged on March 1 and transferred to water in dishes (at Liverpool) on the same night were all dead on March 7 except two. It seemed probable, therefore, that a small proportion of them on the beds might recover if the sea-temperature should rise high enough to permit the ciliary rejection mechanism to work satisfactorily. Dredge hauls on March 12 and 13, when the temperature had risen to 4·5° C., however, failed to yield any living Brittany oysters.

On the same rivers in localities adjoining parts of the beds where Brittany oysters were relaid, estimations were made of the mortality rates in native oysters, mostly brood and half-ware. Among 5,312 natives dredged, 2,734, or 51 per cent, were recently dead, the percentages ranging from 42 to 69. A large proportion of the dead still contained oyster meats. A striking feature was the selective mortality of the larger individuals, which had mostly succumbed. On one bed where a large stock of ware natives was stored in 5½ fathoms at low water, the mortality was as great as 58 per cent. Great losses have also occurred in the store pits, where stocks are often held for convenience at this time of the year. It is certain that there will be further additional mortality.

There can be little doubt that this heavy loss of life is due to the severe frost and its consequences. The temperature of the estuarine water fell to 0° C. by January 1, and ice began to form on the surface on January 17 during the cold period January 20–24. Thick ice blocks formed later and persisted for a month; these prevented continuous navigation, caused ships to drag or to part from their moorings, and marking beacons to be carried away or beaten down into the ground.

It is not clear what the actual cause of death is. The survival of fewer Brittany oysters on the Roach, and of fewer natives in the creeks of both rivers, suggests that the persistent low temperature and melted snow water produced their greatest effects in the shallower and more enclosed waters. Greater mortality on the inshore grounds off Whitstable is a similar phenomenon.

The probable causes are: (*a*) a gaping condition due to relaxation and paralysis of the adductor muscle as a result of a prolonged period of low temperature, for example, six weeks round about 0° C., and (*b*) great reduction in salinity at a low temperature by melted snow, causing grave disturbances in the tissues. Relaxation of the muscles permits accumulation in the mantle cavity of mud which cannot be evacuated by normal means at this temperature.

The frozen sea at Seasalter abreast of the Pollard oyster fishery, January 23, 1940. Photo by courtesy of S. D. West and Son, Whitstable.

The American slipper limpet, *Crepidula fornicata*, was weakened everywhere by the severe cold conditions. It was possible to separate six out of the ten members of a good chain with fingers weak and numb with cold. Ordinarily, separation is effected with considerable difficulty with a knife. Broken chains exhibiting the flesh of exposed individuals were common in the dredgings, and the flesh had a peculiar watery appearance. There can be little doubt that great numbers of slipper limpets will have perished. A chain of limpets from the Roach transferred on March 1 to warmer conditions in the Liverpool tank room recovered by March 7 to form a fairly strongly united chain. It is clear that a rise in temperature on the beds would quickly revive the affected limpets.

On the other hand active *Carcinus* (a few in berry), *Hyas araneus* (quite common in newly extruded berry), *Eupagurus* sp. *juv.*, *Buccinum undatum* (with abundant masses of recent spawn), *Solaster papposus juv.*, one *Asterias rubens*, *Ascidiella aspersa*, other simple Ascidians and *Alcyonidium mytili* were fresh and had apparently withstood the rigours of the winter.

Specimens of *Urosalpinx cinerea*, the American tingle, were taken and quickly began to crawl when transferred to warmer water in dishes at Liverpool. No *Purpura* or *Murex* (*Ocinebra*) were captured. In the severe weather of 1929–30 *Murex* was definitely almost annihilated[1], and *Urosalpinx* gained the ascendant; it is not clear yet to what extent, if any, the recent frost has affected *Urosalpinx*. Information may be obtainable by special dredging later in the year.

It is clear from the data that there is selective mortality among relaid oysters; the Brittany's having suffered virtual total loss and natives to the order of 50–60 per cent; also natives relaid from other rivers, for example, Kent relaid in the Roach, show a slightly higher mortality (47 per cent) on adjacent grounds than local natives (42 per cent). In the most resistant groups the mortality at the time of the survey ranged from 42 to 45 per cent.

It is clear that the stocks of oysters in the Thames Estuary are now reduced to a seriously low figure. As stocks on the Fal beds[2] are also low, English native oysters can seldom have been rarer than they now are, and the culture in as precarious a position. To improve the stocks it is probable that Government loans will be needed for the purchase of French brood and half-ware, and it is desirable that the excellent progress made by the Government in experiments on artificial production of oysters in ponds should be continued for the purpose of supplying cheap spat. It is an interesting fact that when stocks were at a very low ebb in 1935 an exceptionally good spatfall occurred in the summer of that year. Such good fortune may not always occur.

It is, moreover, highly desirable that researches be undertaken on (*a*) the effect of prolonged low temperature on the native oyster, *Ostrea edulis*, with and without varying salinity, and (*b*) the effect of deficiency of oxygen (as might occur in the store pits) in continuous low temperature. These problems have an intimate relation to successful oyster culture.

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March 30.

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[1] Orton, J. H., and Lewis, H. M., *J. Mar. Biol. Assoc.*, **17**, 2 (1931).

[2] Orton, J. H., *J. Mar. Biol. Assoc.*, **24**, i, 331–335 (1940).

Points from Foregoing Letters

J. W. McBain surveys present knowledge of the so-called colloidal electrolytes. He believes that ionic micelles begin to form in very dilute solution and increase steadily with the concentration of simple ions; lamellar micelles arise from ions-pairs and higher aggregates, and produce X-ray patterns in the solution as soon as they have grown sufficiently large.

Y. Nishina and his collaborators of the Institute of Physical and Chemical Research, Tokyo, in association with H. Arakawa, of the Central Meteorological Observatory, Tokyo, have examined the relation of cosmic ray intensity at Tokyo to the position of developed cyclones during 1937. They find that the intensity is low in the warm front and high on the cold front. Thus cosmic ray data can give information on conditions in the upper air.

When polished surfaces of some ancient leads containing inclusions of litharge are etched with boiling, dilute hydrochloric acid, dendritic crystals of lead appear at the junction of lead and litharge and grow outwards from the lead continuously during the etching process. J. A. Smythe finds that these appearances are the result of reactions taking place during etching, whereby lead is autogenously precipitated from the solution of its salt formed by the action of the etching acid on the litharge.

Cammidge and Howard have published certain results concerning the genetics of hyperglycæmia in mice and suggest that the hyperglycæmic condition is recessive and is not linked with albinism. H. Grüneberg and J. B. S. Haldane now produce results and conclusions which indicate that the results of the former two workers should not be accepted until other workers have been able to confirm them.

S. R. Bose has succeeded in reproducing experimentally the behaviour of the basidia of many Polyporaceæ, which at the end of the rainy season and during intervals between two showers of rain gradually become transformed into hyphal elongations with terminal spores; conversely, on the advent of rain in the middle of a dry season, the hyphal elongations revert to regular basidia. Thus the author concludes that this behaviour of basidia is controlled chiefly by their water relations.

S. Banerjee, P. B. Sen and B. C. Guha have shown experimentally that in tuberculosis there is a large reduction in the urinary output of total ascorbic acid but a tendency to a relatively greater excretion of combined ascorbic acid. The ascorbic acid probably, therefore, serves as a detoxicating agent, combining with the toxins and becoming eliminated in that condition.

According to H. Barraclough Fell, it is found that the Australian ant *Chalcoponera metallica* preys principally upon larvae of Lepidoptera and Coleoptera. A single colony of a few hundred individuals can destroy more than 45,000 grubs in a year. It is thus of considerable agricultural importance.

On the Blackwater and Roach Rivers (Essex) J. H. Orton found that the whole of the stocks of imported Brittany—and more than 50 per cent of native—oysters were dead in a survey of February 29–March 1; more natives succumbed later. The causes of mortality are discussed. Temperatures about freezing point prevailed continuously for about six weeks and ice-flows were present in the estuaries for about a month. The effects of these conditions on other marine bottom fauna are noted. It is shown that oyster-culture in England is in a precarious position, that the help of the Government is needed for its recovery, and that certain researches might very well help towards more successful oyster culture.

RESEARCH ITEMS

Travellers in Tibet

A SERIES of communications by the late H. Hosten, S.J., dealing with records of Jesuit missions in India in the seventeenth and eighteenth centuries, published recently by the Royal Asiatic Society of Bengal (4, 1938, No. 4. *Letters*, 1939) includes correspondence, for the greater part unpublished, of the Jesuit missionary, Fr. Ippolito Desideri, with the authorities of his order at Rome in the years 1713–21. He left Rome at the end of September 1912, and arrived at Joa in August of the following year. On June 26, 1715, accompanied by Fr. Manoel Freyre, he arrived at Leh (Ladakh) by way of Srinagar, Kashmir. Up to this point Desideri was aware only of the existence of two Tibets, a Little Tibet (Baltistan) and Great Tibet (Bhutan). In Ladakh he heard of a third, a Great Tibet, U-Tsang, of which the capital was Lhasa. Desideri's object in visiting Tibet was to re-establish the Jesuit Mission of de Andrada (1624–1640) which he now erroneously concluded had been in Lhasa, but in fact had been in Tsaparang. Desideri reached Lhasa on March 18, 1716, but as the Capuchin Mission claimed priority there he was recalled in 1721. He returned to India and finally reached Rome on December 23, 1727. While from the point of view of evangelization his career in Tibet was a failure, he learned Tibetan, which he wrote in both prose and verse, translated Tibetan books, and may have composed, as he intended, a catechism, grammar and a dictionary for the use of the Capuchin Fathers. In addition to interesting material relating to Tibetan society, Desideri records how "this great kingdom of Great Tibet fell into the hands and power of the Tartars", an event which took place during his stay in Lhasa.

Kurds of the Rowanduz Area, Iraq

AN account of the Kurdish social organization in the Rowanduz area of Iraq by E. R. Leach (Monographs on Social Anthropology No. 3 : London School of Economics, 1940. Pp. 74+16 plates. 5*s*.), based upon evidence collected in a five weeks survey carried out in 1938, records data relating to a people and an area concerning which information is scanty. Although linguistically of 'aryan' rather then 'semitic' stock, a close correlation undoubtedly exists between Kurdish social forms and those of Arabia in general. The study, which deals with contrasting factors of cohesion and conflict that affect the lives of this small group of people, rather than with "manners and customs", in other words ethnographic facts, illustrates once more the futility of attaching psychological labels to cultural groups. Again and again the Kurds as a group have been labelled treacherous, bloodthirsty, lazy, virile, stupid and a dozen other things besides ; this study at least shows that there is no such easy classification, but that while the structural pattern of a society does impose upon individuals some standardization of behaviour, it affects the interests of individuals in widely different ways, and their resulting reactions differ accordingly. There can never be absolute conformity to the cultural norm. Until ten years ago the Rowanduz area was extremely inaccessible. Investigation was confined mainly to the Soran and Balîk tribes of the mountainous region in which poverty of soil, severity of the winter and difficulties of intercommunication between the valleys are the most prominent characteristics. Tribal organization has been much affected by contact with external authority and to-day is undergoing extremely rapid and at times violent changes.

Biology of Parasites of Teak Defoliators

IN *Indian Forest Records*, Entomology, 5, Nos. 4–6, 1939, are three papers on the above subject. P. F. Garthwaite and M. H. Desai deal with one hundred and sixteen species of parasites reared from two moths, namely, *Hapalia machaeralis* Walk., and *Hyblœa puera* Cram., the larvæ of which are common defoliators of teak trees in Burma. They include both primary parasites and hyperparasites. Of the latter, most of them are Chalcids, while the primary parasites are mainly Ichneumonoidea and Tachinidæ. Some further notes on the biology of these parasites are contributed by C. F. C. Beeson and S. N. Chatterjee. The third paper, by P. N. Chatterjee, is a detailed study of the biology and morphology of a single species of parasite, namely, the braconid *Apanteles machaeralis* Wlkn. The work embodied in these three papers is a contribution towards a knowledge of the natural controlling agencies of teak defoliators. This survey of the parasites aims at assessing the value of each species, with the ultimate object of examining whatever possibilities there may be of increasing any desirable species by sylvicultural and biological methods. The two moths referred to are the most important of the teak defoliators. Each passes through thirteen or fourteen generations in a single year, and control by other than biological means is stated to be impracticable. Considerable difficulty has been experienced in getting the parasites identified owing to the great paucity of specialists in the groups concerned. The result has been that only thirty-three out of the one hundred and sixteen species dealt with had been named at the time of publication.

Japanese Gephyrea

UNTIL 1904 only four species of Gephyrea had been recorded from Japan, but in that year Ikeda brought the number up to thirty-seven, twenty-four of which were new. As the result of the examination of three collections, twenty-three species from Formosa, eight species from the Riukiu Islands and fifteen species from Korea, Hayao Satô (*Sci. Rep. Tôhoku Imp. Univ.*, 14 ; 1939) has been able to add eight new species. This brings the total number of Gephyrea now known from Japan and Korea up to ninety. The author not only describes the new species, but also makes it an opportunity for reviewing the whole of the group in Japanese seas. The paper thus provides a most useful survey of our present knowledge, and is furnished with full keys to groups, genera and species. It is provided with five plates illustrating by photographs many of the species. There are also a large number of text-figures.

Amphipod Bathyporeia in Tow-nettings

E. Emrys Watkin has studied the migrations of four species of Bathyporeia at Millport (*J. Marine Biol. Assoc.*, 23; 1939). The species represented live in a sandy bay, burrowing an inch or less into the sand between tide marks. A distinct zoning was found from high-tide mark to low-tide mark. *Bathyporeia pilosa* occurs above the high-water mark of neap tides, *B. pelagica* is a mid-tidal form and *B. elegans* a low-water form. The latter, together with *B. guilliamsoniana*, extends beyond low-water mark. Tow-nettings taken at night over the same area show that these amphipods come out of the sand and swim about, although none is taken in the daytime. The same zoning of the species occurs. The reasons for these migrations are by no means clear, but in his detailed discussion the author suggests that the nocturnal vertical movements into the waters of the tidal flow may be determined, in part, by the influence of the tides, which has some relation to the double breeding cycle in each month. These problems require much further investigation.

Temperature of Grain Heaps

A method of storing grain in Egypt, that has persisted from the times of Ancient Egypt, is the 'shouna' system, in which various types of grain are simply exposed in heaps in the open on a small piece of enclosed land. The method is particularly utilized by banks and money-lenders, part of the value of the grain having been borrowed against this security. Such heaps are built up of most various samples and must be contaminated by pests; the question then arises whether the pests will multiply in the grain under such storage conditions. The possibility has been stressed by Willcocks that under Egyptian conditions hard dry grain in well-ventilated conditions which permit of the powerful drying action of the sun may prove the most practicable method of controlling pests. Rizk Attia has, therefore, recently published (*Bull.* No. 192, Technical and Scientific Service, Cairo, 1939) a very full study of temperature distribution in such a heap of stored grain, associated with studies of pest distribution in the grain heap. The kind of grain and especially its colour will modify the range of temperatures, which rise generally in the sun, though loss of water from the heap may produce a considerable cooling effect. All factors found to affect the temperature are tabulated and they are numerous, but in general the results show a marked fall in the number of pests in the deeper layers of an unstirred heap, and especially species of Calandra seemed to be kept under, as the result of the high temperatures, in heaps stored in the sun. In general, wheat at humidities higher than 32 per cent will absorb water and increase in weight; at lower humidity it usually loses water.

The 'Rhizosphere'

Under this term A. G. Lochhead, Dominion agricultural bacteriologist, includes the soil in the immediate neighbourhood of a growing root system, and in a series of recent papers (*Canadian J. Res.*, 16, 152–161; 1938: 16, 162–173; 1938: 18, 42–53; 1940) he has examined the influence of the root system upon the bacterial flora. In the rhizosphere gram-negative rods are proportionately increased, gram-positive rods, coccoid rods and spore-forming types less abundant. In the rhizosphere there is a notably greater proportion of motile forms and a pronounced increase in chromogenic types, also a higher incidence of liquefying bacteria and of those fermenting glucose. To date, Mr. Lochhead concludes that his results suggest that plant varieties resistant to soil infection may exhibit a more selective action through root excretions upon the saprophytic soil microflora.

Origin of Maize

P. C. Mangelsdorf and R. G. Reeves (*Bull.*, 574, Texas Agric. Exp. Stat.) provide a fascinating story concerning the origin of maize. This thorough and penetrating analysis of the taxonomy, history, archæology, genetics and cytology of the Maydeæ summarizes the previous work on the subject and puts forward a novel theory of the origin of maize. Zea is definitely of New World origin, and is closely related to Tripsacum and Euchlæna. It had been assumed either that these three genera are segregates of a large aggregation or that Zea arose from Euchlæna. The authors bring forward the view that maize arose from a wild Amazonian progenitor, and was brought into domestication in the Andes. The secondary large distribution centre is Mexico and is believed by the authors to have arisen from crossing between Euchlæna and Zea. The most interesting hypothesis is that wild Euchlæna arose originally from crosses between wild Tripsacum and cultivated Zea. The wealth of data derived from actual cytogenetical experiments, taxonomy and history make this theory highly plausible. If one prefers to follow the older theory that maize originated from wild Euchlæna, this well-designed monograph still provides a standard source of reference on the origin of maize.

Exchange between a Metal and its Ions in Solution

In experiments with radioactive lead, Hevesy and Biltz in 1929 showed that there is an exchange of atoms between metallic lead and a solution of a lead salt: in an hour, the quantity of lead exchanged corresponded with a depth of about a thousand atomic layers in the metal. B. V. Rollin (*J. Amer. Chem. Soc.*, 62, 86; 1940) has prepared radioactive silver ^{106}Ag by bombarding palladium with deuterons, using a cyclotron. By treating a silver plate with a solution of the radioactive silver nitrate, it acquired an activity corresponding with an exchange with the solution of about 150 atomic layers after some hours. Sheets of gold and platinum also acquired an activity corresponding with about 100 atomic layers. When an active silver surface was shaken with silver nitrate solution, an exchange of silver corresponding with ten atomic layers was found in two hours. The exchange was increased by a factor of ten if the surface was pretreated with sodium nitrate solution, which may be due to some kind of activation of points on the surface of the silver by sodium ions.

Separation of Isotopes

The method of Clusius and Dickel for the separation of gases of different molecular weights, and particularly isotopes, using simultaneous thermo-diffusion and convection, has proved of considerable value in the separation of mixtures of gaseous isotopes into light and heavy fractions. In its simplest form the apparatus consists of a long vertical tube, cooled on the outside, along the axis of which passes an electrically heated wire. The apparatus was used by Clusius and Dickel to alter the isotopic composition of chlorine, ^{35}Cl : ^{37}Cl, from

77 : 23 to 0·6 : 99·4. Many light elements contain very small concentrations of isotopes which are of interest from the point of view of nuclear physics, and their enrichment is therefore a matter of some importance. R. Fleischmann (*Phys. Z.*, 41, 14; 1940) reports experiments carried out with nitrogen. With two separation tubes of 9 mm. and 11 mm. diameter and 12 m. long, 770 c.c. of gas containing 9·2 per cent of $^{14}N^{15}N$ were obtained in six weeks, and from this, 110 c.c. of gas containing 18 per cent of $^{14}N^{15}N$ were obtained. The band spectra of the products indicated that separation had occurred. W. Groth and P. Harteck (*Naturwiss.*, 28, 47; 1940) have recently carried out separation experiments with krypton using an apparatus of a similar type. After 5–8 days separation, the atomic weight of the krypton was 1·51 units less than normal, and after 9–14 days it was 1·74 units less. The large amount of work done on isotopes is reflected in an article by O. Hahn, S. Flügge and J. Mattauch, appearing in a recent issue of *Phys. Z.* (41, 1; 1940). It includes a table giving all relevant data for each element up to the end of 1939. The isotopic weights, and relative abundance of all known isotopes, together with packing fractions and mass defects, and the chemical atomic weight calculated from the isotopic composition of each element, are given. The maximum abundance of isotopes at present undetected is also given.

High Temperature Photolysis of Acetaldehyde

G. K. Rollefson and D. C. Grahame (*J. Chem. Phys.*, 8, 98; 1940) report that the mechanism of the photolysis of acetaldehyde vapour is almost identical with that put forward to explain the thermal decomposition of acetaldehyde. Photolysis was carried out by 3130 A. and 2652 A. mercury radiation at 96°–350° and by 3303 A. at 60°–300°. The mechanism, by which methyl and formyl free radicals are formed and through them further decomposition of acetaldehyde is brought about, can be represented as: (i) $CH_3CHO + h\nu \rightarrow CH_4 + CO$; (ii) $CH_3CHO + h\nu \rightarrow CH_3 + CHO$; (iii) $CH_3 + CH_3CHO \rightarrow CH_4 + CH_3CO$; (iv) $CH_3CO \rightarrow CH_3 + CO$; (v) $CHO \rightarrow CO + H$; (vi) $CH_3CHO + H \rightarrow CH_3CO + H_2$; (vii) $CH_3 + CH_3 \rightarrow C_2H_6$. Photolysis of the mixed vapours of acetaldehyde and acetone at 200° and 300° has also been studied. At 3130 A. more free radicals are produced from acetaldehyde than from acetone, whilst at 2652 A. acetone yields more free radicals than acetaldehyde. Neither acetone nor acetaldehyde shows any afterglow $\frac{1}{400}$ sec. after irradiation with 3130 A., indicating either that their fluorescence does not arise from recombination of acetyl radicals (that is, from activated diacetyl molecules) or that the life-time of acetyl radicals is less than $\frac{1}{400}$ sec.

A New Ionization Gauge

THE requirements of an ionization gauge to measure pressures of the order 10^{-8} mm. of mercury are: a wide connecting tube, ease of removing occluded gas, electrical leakage to the plate small, and reasonably high sensitivity. R. S. Morse and R. M. Bowie, of Distillation Products, New York, claim that their new gauge fulfils these demands more thoroughly than any gauge previously described (*Rev. Sci. Inst.*, March 1940). The bulb of the gauge is 5·5 cm. in diameter, of Pyrex glass, with an exit tube of 1·6 cm. diameter. The plate or collector is a platinum film deposited on the inner wall and is connected to an outside deposited ring by a fine wire embedded in the glass. The grid is a double wound spiral of tungsten wire, each end having a terminal. The filament is pure tungsten. Owing to the large volume between grid and plate and the open form of the grid, the sensitivity is higher than usual. Below pressures of 10^{-4} mm. the plate current is found by comparison with a McLeod gauge to be proportional to the pressure. The best working conditions are 3·5 volts for the filament, 150 for the grid and −25 for the plate.

New Method in Quantum Mechanics

A NEW method for determining eigenvalues and eigenfunctions has recently been developed by E. Schrödinger (*Proc. Roy. Irish Acad.*, A, 46, 9; 1940), which, he considers, gives the most direct insight into the way the line spectrum depends on the structure of the wave equation. This method avoids cumbersome transformations and expansion in power series, using instead the factorization of the second order operator occurring in the wave equation into two mutually adjoint operators of the first order. For the problem of Planck's oscillator, it gives one eigenfunction by integration of a very simple differential equation, and then derives all the other eigenfunctions and their corresponding eigenvalues by application of a differential operator of the first order. Prof. Schrödinger also applies the method to the Kepler motion of the hydrogen atom, and also to Kepler motion "in the hypersphere" (that is taking account of the curvature of the universe). This last problem is a new one, which appears difficult when treated by any other method. It has some interesting features, such as the obliteration of the sharp distinction between elliptic and hyperbolic orbits, and the resolution of the continuous spectrum into an intensely crowded line spectrum.

Solar Eclipse of October 1, 1940

A COMMUNICATION from the U.S. Naval Observatory, Washington, D.C., published as a supplement to the American Ephemeris of 1940, gives much useful information concerning the total eclipse of the sun on October 1. The booklet is designed especially for use along the paths of totality in South America and South Africa; but the entire region covered by the eclipse on both continents is indicated on two large-scale maps (c. 150 miles to the inch) contained in a pocket on the cover. Red lines overprinted on these maps show the times of beginning and ending of the eclipse at 5- or 10-minute intervals, so that even for points not in the path of totality the times of beginning and ending of the partial phase can be estimated to a fraction of a minute. Data are given dealing with the meteorological conditions that prevail in or near the paths of totality, and the most favourable locations for observing the eclipse are suggested. In addition to the usual astronomical data, eight pages are devoted to the convenience of those who plan to make ionospheric observations during the partial and total phases, for the purpose of testing various hypotheses underlying the theory of origin of the *E* region of the ionosphere. In an appendix are reprinted special temperature, rainfall, and cloudiness data compiled from volunteers' observations made within the African totality belt at 3, 4, and 5 p.m. local time during September and October for a period of five years since September 1933.

FOREST MANAGEMENT AND EROSION

By Prof. E. P. Stebbing,
University of Edinburgh

THE criticism has been made that Government administration annual reports from overseas often appear so belatedly that their perusal bears little relation to the probable actual position at the time. Two annual reports of the Forest Administration of Nigeria for the years 1937 and 1938 were published in 1939 (Sessional Papers Nos. 3 and 34: Government Printer, Lagos). Nigeria has been notorious for the delay in appearance of her forestry reports. That such delays are not insuperable would appear from the fact that the report for 1938 is dated by the writer February 27, 1939, and is published in the same year!

Although a chance, it is perhaps of some significance that these two annual reports should have appeared so opportunely within a short space of time; for taken together they may well be said to mark an epoch in the history of the progress (or in some cases want of progress) of forestry administration in that country. Both reports were written by the acting chief conservator of forests, an officer with long acquaintance of Nigeria, and especially of the northern regions. A vast improvement of form is achieved by the relegation of statistics to appendixes.

As the chief conservator says, the year 1937 was marked by several events of considerable importance. Early in the year the Anglo-French Forestry Commission completed its investigation of desiccating conditions in the Northern Provinces and the French territories beyond on the edge of the Sahara. Its report did not fulfil the high hopes which had been placed upon the Commission, whose investigations were unfortunately of too hurried a nature to afford material of great practical value. In the following July the Nigerian Government convened a Conference which met in Lagos, consisting of high officials representing several Departments, the object being to examine and make recommendations on the future policy of the Forestry Department. Great hopes were placed on the resolutions of the Conference, and 1938 opened out with very great promise for the Department. The optimism was, however, soon quenched. Once again, as so often before, a depressed financial situation at once reacted on the Forestry Department, the prospective increases were withdrawn, and the basic funds at the Department's disposal had, says the report, "necessarily to be reduced".

The reports throw into a strong light what has often been pointed out, the vacillating methods upon which forestry administration has been carried on by the Governments of Colonies. In 1937, as a result of a conference at which some of the highest members of the administration were present, a forest policy was determined upon and provision made to put it into force the following year. Almost before the ink of the attached signatures was dry, funds were withdrawn and once again stagnation was to supervene.

That in the interests of the country as a whole, continuity of the work of the Forest Department should be maintained, is illustrated by the following remarks in the 1937 report:

"The general examination of forests by field officers has revealed the immense importance and urgent necessity of planning. The continued and universal damage to unreserved forest and the indiscriminate encroachment in reserves emphasise the necessity of distributing the available staff to the best advantage. . . . Reservation and consolidation of the existing reserves must, of course, take first place. . . . In areas where reservation has not yet reached the required percentage and where cocoa is a popular crop, planning is all the more necessary. Many such areas are unfitted climatically to maintain cocoa as a permanent crop and the wildly unbalanced expansion which takes place after a boom must not only lead to disaster in the area itself but must also have repercussions in adjacent climatic 'tension' areas."

In his 1938 report the acting chief conservator writes that "Reservation, management and research; each must play its part"; but adds, after stating that forest reserves established must as soon as possible be placed under some form of management, "no unavoidable delays can be permitted to stand in the way of building up the total of reserved forest required".

The acting chief conservator does not appear to have quite made up his mind as to whether the most important of the duties of the Department at the present time are "to secure the existing forest estate" or the "building up of the total reserved forest required". He rightly says that no great progress in forest management can be made until the necessary percentage of forest estate is secured, and continues: "It is nevertheless equally necessary, because of the limited area of merchantable forest in Nigeria, to place under management such a proportion of this area as has been secured, without diverting to the purpose an undue proportion of the staff or funds available. Comparisons, invidious sometimes, are made with India and other Colonies in the matter of relative progress in the different branches of the Forest Department, but there is no real analogy. Our merchantable forest wealth, which is an Imperial asset as much as a Nigerian one, must be put under management as soon as possible and cannot wait for the completion of the whole framework of reservation throughout the country, a task which may take anything from fifty to eighty years at the present rate of progress."

Why? Is this logical? How much of the forests of these proposed future reserves will remain, and what will be the condition of the area left (and that of the surrounding countryside) at the end of this period of 50–80 years?

As to this comparison with India and Burma, the Burma teak forests were very much of an Imperial asset when the late Sir Dietrich Brandis began, as soon as he joined in Pegu, his enumeration surveys to ascertain the stocking. By this work he was able to maintain the continuity of supply to the European and Indian markets, which was imperative, whilst at once putting an end to unchecked fellings. But this work did not hold up forest reservation either in India or Burma. By the end of the century, a period of little more than thirty years, the framework of reservation throughout Indian and accessible Burmese forests had been accomplished, whilst considerable management had been introduced into the forests. The pity is that after about the same number of years of forestry in Nigeria the Forestry Department should have much forest reservation still to be undertaken, owing to the fact that its real position in the Administration has never until recently been understood, save to be regarded primarily as a revenue producer.

Perhaps one of the most important and progressive pieces of work the Department has undertaken during the last few years has been an outcome of the Anglo-French Commission, on the British side. Two special anti-desiccation and vegetational survey teams were appointed to carry out desiccation investigations in the Northern Sokoto, Katsina, and Kano Provinces. A special report on the Sokoto area has produced, says the chief conservator, "a very interesting set of conclusions, which are briefly that 'desiccation' in Sokoto in the form of encroachment of the Sahara is not apparent, but that all the conditions present are due to the activities of man and of domestic animals". If the writer will study the history of parts of the south-west Sahara, he will find, to quote one instance, that the howling Desert of Mauretania, situated some 400 kilometres to the west of Timbuctoo, was the centre of the great Empire of Ghana from the ninth until the eleventh centuries, when the region consisted of smiling fertile lands. It now forms part of the Sahara. The great desert did not advance over the area in sand-waves. As the writer says above, "the activities of man and domestic animals" gradually produced the result, and the region was added to the Sahara; just as the areas comprised in Sokoto and Katsina, if the present-day activities continued unchecked in the two provinces, would infallibly be added to the great desert, which would have thus 'encroached' on the area.

Members of the Society of American Foresters met in San Francisco last November. Charles A. Connaughton, of the U.S. Forest Service, discussed (Science Service, Nov. 21, 1939) problems of watershed control; they were difficult, he pointed out, because owners of watershed areas seldom receive the benefits of control measures, which cost money and labour on the spot but go mainly for the help of lands farther downstream! . . . He continued: "Rangeland research is needed for the solution of problems arising out of overgrazing, which not only brings about the displacement of good forage species by weeds but even the destruction of the soil itself through erosion. Research now in hand has already suggested that native grasses and other plants, rather than exotics, may be the best for rangeland restoration, but more research is needed to arrive at really definite conclusions. Another possible result of researches now in progress is the upsetting of the old idea, accepted almost as an axiom, that livestock and larger game animals cannot use the same range without robbing each other. Apparently, both livestock and wildlife can be produced without serious conflict on most ranges."

The forestry remedial measures (given in the 1938 Nigerian report) to be put into force in Sokoto are excellent, and indicate that this serious problem is now to be tackled with understanding; and, unlike the American rangeland and watershed problem (though Africa has the same elsewhere), the amelioration work to be undertaken in Sokoto, and extended eastward, will benefit alike the people within the area and others situated to the south.

In the Forest Report for Palestine for the period 1936–39 (Printing and Stationery Office, Jerusalem, 1939), it is stated that the total land area is some 10,000 square miles; the hills are mostly composed of limestones, with basalt intrusions in the north-east, whilst the plains are deeply covered with alluvium. The climatic desert accounts for something less than half the area; of the remainder, 45 per cent are plains and 55 per cent hilly country. The state of the hills is considered to be unsatisfactory, as most of the surface is eroded, and probably less than 1 per cent is agricultural land in good condition. The hills, it is said, were undoubtedly once covered with soil and forest, whereas they are now an artificial desert due to overgrazing. The river valleys are desolated by floods and the deposition of infertile detritus, the river beds are choked, and road and railway embankments and bridges frequently damaged.

The Forest Department, formed only in 1936, owing to the outbreaks and unrest which supervened so soon after, has scarcely had time to get well into the saddle. Moreover, promised grants were withdrawn, inevitably, perhaps, owing to the unrest. But the Department has already been able to contribute some valuable information on the subject of erosion in the Middle East. On the question of reservation of land areas for afforestation the report states: "In the course of time previous to 1936, the natural vegetation was cleared from nearly all the fertile areas of Palestine, and such vestiges as remained were on the most rocky and barren land. Even there the vegetation was almost ruined by excessive grazing and uncontrolled cutting. In consequence, the present value of the vegetation and of the land on which it stands is very low, and most of the Forest Reserves cannot be made highly productive without many years of careful management. Closure and protection, however, will very early result in the checking of erosion and flooding, and are therefore of the utmost value."

Man's old habits—fire and excessive grazing—have probably been the chief two causes for the present condition of so much of Palestine. On the subject of fire, the report says that the climate of the country, with its long summer drought, atmospheric desiccation, and dry, hot winds, is very conducive to forest fires, which would be more serious but for the sparseness of the vegetation in most places—which tells its own tale as to the downgrade of the country as a home for man, or even for his goats. The present position of grazing shows the determining factor in this latter question. The following paragraph might have been written of other areas within the British Empire; but here it possesses its own significance: "Except for the well-bred cows on a few modern dairy farms which grow fodder in irrigated fields, the grazing animals of Palestine have to depend on the grass, shrubs, and young trees which Nature provides on uncultivated land. Their only change of diet is the stubble on the cereal lands after harvest. Centuries of such treatment have produced a tough and agile goat which can consume organic matter of almost any type. The sheep, mostly of the fat-tailed breed, are also very hardy. The camel, fortunately less common in the northern districts, eats what the goat cannot reach. No attempts have been made to estimate the permanent carrying capacity of the land, the number of animals grazed is limited only by drought, starvation and disease; and the vegetation is destroyed over large areas, which have become artificial deserts in spite of good climatic and geological factors. Soils were nearly everywhere excellent before they were removed by erosion. All other forms of damage fade into insignificance beside the destruction caused by grazing, though the process is accelerated by cutting and uprooting."

Yet there are still some who dispute that obvious factor on the globe, the man-made desert—both of the past, and those of more modern origin, and in the making.

Forestry problems of increasing magnitude and importance are many in the British Colonial Empire.

The welcome and wide-visioned Colonial policy recently announced by the Secretary of State offers, it may be hoped, opportunity that in the future continuity in a forest policy, duly drawn up and sanctioned, may be persisted in, whatever vicissitudes befall the Colonial budget; and, above all, that recognition should be accorded to the factor that the scheme for reservation of the forest areas in any Colony considered needful to its economic progress, the protection of its water supplies, etc., upon which the agricultural prosperity depends, should take precedence of other work. The policy, as laid down for Nigeria by the 1937 Committee, that foreshadowed in the Palestine Report, and those so often voiced for other Colonies, should now become practical politics in view of Mr. Malcolm Macdonald's masterly White Paper.

ECONOMIC PROBLEMS OF INDUSTRIAL SCIENTISTS

A SERIES of regional conferences to discuss the economic problems of men of science and engineers employed in industry has recently been held in London, Liverpool and Manchester. Others are to follow, and it is intended that a national conference shall be held in the autumn in order to collate the information obtained at the regional conferences. The conferences are being organized by the Association of Scientific Workers, but many members of other professional organizations attended the meetings and took part in the papers and discussions. It is hoped that this collaboration will continue and increase as a result of the interest aroused.

The London regional conference, held on March 9, with Prof. F. G. Donnan in the chair, was opened by Mr. Hugh N. Linstead, with a general discussion on the place of the scientific worker in industry and on the role of professional organizations. He pointed out that, in view of the great importance of the role of the scientist in modern industry, the discrepancies between the salaries of scientists in industry as compared with those in administrative positions can only be rectified by scientists organizing themselves. Such an organization must protect the interests of the scientific worker, but be broad enough to consider the problems of the industry and the employer as well. In spite of the prejudice against trade unionism among professional workers, the trade unions play an essential part in industry, and both the scientist and the community suffer from lack of this type of organization among scientists.

This was followed by a paper by Mr. J. Stewart Cook on the question of salaries, increments, overtime, etc. His paper consisted of a factual analysis of the data available in these questions as they affect both graduate scientists and assistants, and was based on the results of a questionnaire sent out by the Association of Scientific Workers, and on data published by the Institute of Chemistry. He considers that salaries will only be uniformly adequate and satisfactory when scientists are organized on such a basis that they can and will refuse to take jobs below prescribed rates. He pointed to the good record of the British Association of Chemists in this respect, attributing its success to the policy of maintaining an appointments board, backed up by an unemployment scheme.

The rights of publication were discussed by Mr. H. T. Rhodes, and the question of holidays and opportunities for study by Mr. J. L. Pinder. The latter stressed the necessity for adequate holidays and opportunities to attend scientific lectures, if the scientist is to produce his best work. He is in favour of a 5-day week. The question of adequate time for study as well as for recreation is essential for assistants studying for degrees. He considers their position in this respect is often unsatisfactory.

The problems of the assistant were dealt with by Mr. R. Peter, himself an assistant. The assistant is faced with the double task of satisfying the employer by day and the examiner by night. The principal requirements of assistants are (1) standardization of working hours throughout industry, (2) standardization of wages based on some grading system of age and qualifications, (3) a definition of work expected on engagement and a limitation of this, in general, to technical matters, (4) allowance of adequate time for study and recreation and provision of financial assistance where necessary for the cost of study.

A paper was then given by Mr. F. W. Adams dealing with the legal side of scientific employment, in which he discussed the questions of contracts, of copyright and the right to seek alternative employment.

Prof. J. D. Bernal, in summing up, pointed out the similarities and the differences in the position of scientists in this War and that of 1914–18. Since 1918 the scientist and the laboratory have become an integral part of industry, but there has not been the development of organization of scientists which has occurred in other spheres of industry. Bad conditions for scientists mean a depression in productivity of industry. The increasing number of assistants entering the ranks of qualified scientists means that the whole range of the problem from assistant to directorate must be tackled, as an anomaly in any one section would be felt by all other sections of industrial scientists, and also by academic and Government employees. He considers that scientists as salaried workers require some type of trade union organization which would include organization of assistants. The details of such an organization would require special study, but the immediate consideration is the building up of organizations such as the Association of Scientific Workers and the British Association of Chemists.

The Liverpool Conference was held on March 4, and was opened by Mr. J. P. Lawrie with a general discussion of the questions involved. This was followed by a factual paper on assistants, their status and problems. A survey of contemporary professional organizations was then given. It was pointed out that a very large number of professional workers, such as teachers, medical men and journalists, are already organized in trade unions. In purely scientific fields the degree of organization is comparatively very low. The learned societies are precluded by their charters from activities affecting the economic conditions of their members, and the field is still open for vast development. The British Association of Chemists, with 2,000 members, has been registered as a trade union since 1920. The Association of Scientific Workers, with 1,500 members, is not now a trade union, but interests itself in economic activities. Mr. Lawrie then gave a survey of advertisements for scientific posts and a statistical analysis of the material collected regarding salaries was given. The position of women scientists was considered and the discrepancy in wages pointed out. It is realized that this question has increased in importance since the War began.

The Manchester Conference was held on March 16, with Prof. Willis Jackson in the chair. Prof. H. Levy, in opening the discussion, said that scientists are not brought up in an industrial atmosphere, and the idea of trade unionism is, consequently, foreign to them. He showed that the same forces operate with industrial scientists as with manual workers. He then analysed the different types of scientific work and discussed the impact of the War on science and on scientists. This was followed by a paper on basic salaries, increments, cost of living adjustments, etc. The question of contracts was the subject of the next paper, and the anomalies and lack of standardization was pointed out. After this, the problems of students were discussed, especially under the conditions of the War. The effect of conscription and the increase in the cost of living due to the evacuation of universities were dealt with.

The final papers dealt with the rights of publication and the problems of the laboratory assistant. In the latter, the main problems were considered to be: diversity of labour, lack of standardization, salaries, absence of status, promotion and unskilled labour, especially since the outbreak of war.

All three conferences were very well attended and were accompanied by lively discussion from the floor. The two salient features of the conferences were the realization of the growing role which the laboratory assistant takes in industrial science, and the feeling that the War is raising acute economic problems for scientists and an active organization is needed capable of protecting their interests.

A full report of the conferences will be given in the April–May number of the *Scientific Worker*, the organ of the Association of Scientific Workers.

DRUG STANDARDS FOR INDIA

THE ambition of those enlightened practitioners of medicine in India who, under the leadership of Dr. Chopra, have sought for many years past to bring that country into line with the rest of the civilized world in the matter of standardized drugs now seems to be near achievement. A comprehensive measure providing for the uniform control of the manufacture and sale of drugs as well as the importation of drugs is now before the Legislative Assembly; the introduction of such a Bill is, in itself, no small advance towards the desired goal, since the Bill is backed by resolutions from every one of the provincial legislatures empowering the central authority to pass an Act to regulate the manufacture, distribution and sale of drugs throughout India. No such resolutions were necessary for the purpose of a measure to regulate the importation of drugs, but such limited control would fail to bring about the desired purpose, namely, to create a clean business in medical supplies in every province. It would be of little use to prohibit the importation of inferior drugs if there were no means of preventing the sophistication of imports or the domestic production of inferior preparations. The Bill, when it becomes law, will extend to the whole of India.

So far as imports are concerned, the Bill makes it an offence to import misbranded drugs, by which term is meant, briefly, drugs different from what they are represented to be by the labels on their containers. It specifically prohibits the importation of "any drug which is not of standard quality", and it is interesting to find that the standards with which compliance will be necessary are as follows: (1) proprietary medicines: the list of ingredients described on the label or the formula disclosed to the Central Drug Laboratory, as the case may be; (2) vaccines, sera, toxins and other biological products of a like nature: the standards maintained at the National Institute for Medical Research, London; (3) vitamins, hormones and analogous products: the standards maintained at the National Institute; (4) other drugs: the standards of identity, purity and strength specified in the latest edition either of the British Pharmacopœia or the British Pharmaceutical Codex or any other prescribed pharmacopœia, or adopted by the Permanent Commission on Biological Standardisation of the League of Nations. On the principle of what is "sauce for the goose is sauce for the gander", the part of the Bill which relates to domestic manufacture and to the sale and distribution of drugs is in effect the same as that which applies to the importation of drugs; the standards to be complied with are identical in each case.

IRRIGATION THROUGH THE AGES

On February 16, Mr. E. Bruce Ball, president of the Institution of Mechanical Engineers, delivered an address in the course of which he surveyed "The Influence of the Mechanical Mind on the Development of Irrigation through the Ages".

From the dawn of civilization there is evidence of the activity of the mechanical mind in devising means of watering those tracts of land which could in this way be made highly fertile. Something here might have been said of the skill with which these unlettered people constructed the small channels by which the water was distributed to the fields.

The mechanical devices were introduced at the points at which the water was raised from some stream or well into the basins which supplied the system of channels. The earliest of those was probably what is known as the 'basket scoop', a hemispherical vessel operated by two men by means of two ropes each so that it could be swung up with its load of water and tilted to discharge it. The method is still in use in India and China and gives a lift of about 3 feet. The need for higher lifts and for making better use of available labour led to developments showing great ingenuity in the application of the only available material, timber. The hollowed tree trunk nicely balanced so as to enable one man to operate it, and the moving counterpoise on a balanced beam showed a keen appreciation of mechanical principles. Further improvements on these designs gave increased lift, or effected a saving of energy—no doubt that of the user himself—or again added a simple automatic device to discharge the water when it had reached its full lift or, as in another case, made use of gravity by means of a sloping path to assist tractive effort.

All these methods gave intermittent deliveries—a bucketful at a time—and we then see an important development in the production of a crude wheel carrying a number of buckets and giving an almost continuous delivery. Operated by an ox or a camel through a rough and ready form of gearing, this shows the conception of the machine being evolved. Several illustrations of different pumping or water lifting machines were shown, including one of the gigantic wheel on the Yellow River, and portable link chain pumps. While these and even the most primitive methods of irrigation can still be seen in use in many parts of Asia, and appear but puny efforts as compared with the great engineering works of to-day, it must be borne in mind that the latter have only been made possible by the new materials of construction now available and the machines and power units at the disposal of the great constructors of recent times.

Examples of the great barrages were referred to and illustrations of them and of the machinery essential to their operation shown. The different types of sluice gates and shutters and the system by which the waters are controlled were explained, thus showing how the mechanical mind has harnessed the waters to the purpose of assisting Nature to maintain the population of the world; and although much has been done there are vast resources still awaiting development. Mr. Bruce Ball claims this as but a single illustration of the dependence of human life on the creative work of the mechanical engineer.

SEVENTY YEARS AGO

Nature, vol. 2, May 5, 1870

First Number of the Second Volume of Nature

Sir Norman Lockyer, founder and editor, opens No. 27 of this journal with a short article referring to the achievements of the past six months. He remarks on the encouragement, and criticism, which he has received. "It has been our endeavour to carry out our programme by making the journal useful to workers in science; worthy therefore of their perusal, and therefore, again, worthy of their contributions: and by thus extending our appeal beyond the limits of the scientific world on the one hand, and endeavouring to keep up the dignity of science herself on the other, we have already met with an encouraging response. Our subscribers now number nearly five thousand; that is, we have, on a moderate estimate, fifteen thousand readers. . . .

"We state this, not only because the statement is almost due to our contributors as a justification of our demands on their time, but because it indicates the work—we almost said the noble work—which lies before them. Surely at a time when England would gain so much by the scientific education, not only of her Workmen but of her Ministers, an attempt to place Science before the Public, week by week, as Politics, Art, Music, and a hundred other things are placed before them, must not be suffered to flag; when the number of science-teachers and science-students is daily increasing, and the necessity for combined action and representation among scientific men themselves is being more and more felt, the popularization of science becomes more important than ever."

Why is the Sky Blue?

"H. A. N." has a letter under this title. He remarks: "Is it that the predominant colour of sunlight being orange, the regions devoid of sunlight appear of the complementary colour? . . . Or, again, is the blueness merely the colour of our atmosphere, as Prof. Tyndall's experiments have led some to believe? In favour of the former explanation, is the fact that the maximum intensity of the light of the solar spectrum is in the orange, and indeed that the sun *looks* orange, and if we close our eyes after gazing a moment at him when high up in the sky, we see a blue image. When the sun is low, his colour changes from orange to red, and this would explain the green tints so often seen in the cloudless parts of the sky at sunset."

At a meeting of the German Chemical Society on March 28, Prof. Rammelsberg read a paper on the phosphates of thallium, in which he stated that isomorphism exists between certain hydrogen thallium and hydrogen ammonium phosphates. He claims this is the first proof of the isomorphism of hydrogen with monatomic metals.

Mr. (afterwards Sir) E. B. Tylor read a paper "On the Philosophy of Religion among the Lower Races of Mankind" before the Ethnological Society on April 26. He said that the conception of the soul as recognized by the lower races is the starting point of their religious philosophy, which he described as 'animism'.

A Natural History Society has been established at Winchester College.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Tuesday, May 7

Zoological Society of London, at 5 p.m.—Dr. E. L. Taylor: "On Pseudo-rumination in the Rabbit". Dr. J. S. Huxley, F.R.S., and J. Fisher: "Hostility Reactions in Black-headed Gulls".

Royal Institution, at 5.15 p.m.—Sir John Orr, F.R.S.: "National Food Requirements".*

Wednesday, May 8

Institute of Metals (at the Institution of Mechanical Engineers).

At 2 p.m.—Dr. L. Northcott: "The Influence of Alloying Elements on the Crystallization of Copper, Part 2, Large Additions and the part played by the Constitution"; Dr. Maurice Cook and Dr. T. Ll. Richards: "The Structural Changes in Copper affected by Cold Rolling and Annealing"; Dr. Marie L. V. Gayler and R. Parkhouse: "The Ageing of High-Purity 4 per cent Copper-Aluminium Alloy".

At 7 p.m.—Prof. J. D. Cockcroft, F.R.S.: "The Cyclotron and its Applications" (Thirtieth Annual May Lecture).

Thursday, May 9

Royal College of Surgeons of England, at 4 p.m.—Prof. E. D. Adrian, F.R.S.: "The Nervous Mechanism of Pain."

Institution of Electrical Engineers, at 6 p.m.—Annual General Meeting.

Association of Teachers in Technical Institutions (Thirty-first Annual Conference, at the Hotel Russell, Russell Square, London), May 11–12.

May 12, at 10 a.m.—S. H. Moorfield: Presidential Address.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Electrical Engineering subjects at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 9).

Lecturer in Engineering—The Principal, County Technical College, Stoke Park, Guildford (May 11).

Temporary Civil Engineering Assistants in the Borough Engineer's Department—The Borough Engineer, Town Hall, West Ham, E.15 (May 11).

Assistant Superintendent, Mathematical Instrument Office of the Survey of India, Calcutta—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 290/10) (May 14).

Head of the Department of Chemistry—The Secretary, School of Metalliferous Mining, Camborne, Cornwall (May 15).

Construction Engineer for the Irrigation Department of the Government of Ceylon—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9322) (May 17).

A Senior Lecturer in Civil Engineering, a Lecturer in Civil and Mechanical Engineering, and a Lecturer in Mechanical Engineering, at the Henry Lester Institute of Technical Education, Shanghai—Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, E.C.1 (May 18).

Principal of the Wellingborough Technical Institute—The Secretary for Education, County Education Offices, Northampton (May 20).

Assistant Engineer for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

Assistant Engineer to the River Avon (Bristol) Catchment Board—The Clerk and Solicitor to the River Avon Catchment Board, 11 Marsh Street, Bristol 1 (quoting 'Assistant Engineer').

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Herbage Publication Series. Bulletin 27: The Control of Weeds; a Symposium on the Prevention and Eradication of Weeds on Agricultural Land by Cultural, Chemical and Biological Means. Edited by R. O. Whyte. Pp. 168+26 plates. 7*s.* 6*d.* Bulletin 28: Technique of Grassland Experimentation in Scandinavia and Finland; a Symposium on the Technique employed in Pasture Studies, Botanical Analyses, etc. Pp. 52+2 plates. 2*s.* 6*d.* Bulletin 29: Grassland Investigations in Australia. Pp. 107. 5*s.* (Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) [84

Other Countries

The Engineering Foundation: a Department of United Engineering Trustees, Inc. Annual Report, October 1, 1938, to September 30, 1939. Pp. 47. (New York: The Engineering Foundation.) [34

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 93: Studies on the Marketing of Fresh Fish in Eastern Australia. Part 1: Field Observations and Quantitative Bacterial Results. By E. J. Ferguson Wood. (Fisheries Section, Report No. 2.) Pp. 24. (Melbourne: Government Printer.) [34

Indian Lac Research Institute. Bulletin No. 37: Measurement of Gloss, Transparency and Colour. By N. N. Murty. Pp. 14. 2 annas. Research Note No. 21: Shellac-Casein Moulding Powder. By M. Venugopalan and H. R. Sen. Pp. 4. (Namkum: Indian Lac Research Institute.) [34

Connecticut Agricultural Experiment Station. Circular 126: Control of the Rosy Apple Aphid in Connecticut Apple Orchards. By Philip Garman. Pp. 16. Circular 127: Soil Testing Methods—The Universal Soil Testing System. By M. F. Morgan. Pp. 16. Circular 128: Control of Tobacco Mildew (Blue Mold) in Seedbeds. By P. J. Anderson. Pp. 6. Circular 129: The Sand Culture of Seedlings and Mature Plants. By A. A. Dunlap. Pp. 12. Circular 130: Control of the European Corn Borer by Sprays and Dusts. By Neely Turner. Pp. 4. Circular 131: Soil Testing in Connecticut. By M. F. Morgan, T. R. Swanback and J. S. Owens. Pp. 8. Circular 132: Control of the Japanese Beetle. By J. Peter Johnson. Pp. 14. Circular 133: Control of European Corn Borers on Dahlias. By Neely Turner. Pp. 4. Circular 134: Control of Termites in Buildings. By Neely Turner and James F. Townsend. Pp. 14. Circular 135: The Law concerning Concentrated Commercial Feeding Stuffs and Regulations pertaining Thereto. Pp. 6. Circular 136: Report on Commercial Insecticides and Fungicides, 1939. By H. J. Fisher. Pp. 10. (New Haven, Conn.: Connecticut Agricultural Experiment Station.) [34

New South Wales: Department of Mines, Geological Survey. Mineral Resources, No. 37: The Coal Resources of the Southern Portion of the Maitland–Cessnock–Greta Coal District (Northern Coalfield). By Leo J. Jones. Pp. v+225+4 plates. (Sydney: Government Printer.) 9*s.* [44

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 854: Surface Water Supply of the United States, 1938. Part 4: St. Lawrence River Basin. Pp. v+149+1 plate. 25 cents. Water-Supply Paper 859: Surface Water Supply of the United States, 1938. Part 9: Colorado River Basin. Pp. vi+285+1 plate. 35 cents. Water-Supply Paper 864: Surface Water Supply of the United States, 1938. Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. v+184+1 plate. 25 cents. (Washington, D.C.: Government Printing Office.) [44

Commonwealth of Australia: Council for Scientific and Industrial Research. Handbook of Structural Timber Design. Prepared by Ian Langlands and A. J. Thomas. (Division of Forests Products: Technical Paper No. 32.) Pp. 283. (Melbourne: Government Printer.) [44

Antarctica. Produced by the Property and Survey Branch, Department of the Interior, Canberra. 2 sheet Map, 60 in. × 40 in., 7*s.* 6*d.*, including Handbook. 1 sheet Map, 30 in. × 40 in., 5*s.*, including Handbook. Handbook and Index by E. P. Bayliss and J. S. Cumpston to accompany a Map of Antarctica, 1939. Pp. 90. (Canberra: Department of External Affairs.) [44

Ministry of Public Works: Irrigation Department, Hydraulic Section. Hydraulic Features of the Nile Flood of 1938. Pp. vii+30+17 plates. (Cairo: Government Press.) [54

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 224: Control of Smut Diseases in Egypt with Special Reference to Sowing Depth and Soil Moisture. By G. Howard Jones and Abd El-Ghani Seif El-Nasr Eff. Pp. iv+46+7 plates. (Cairo: Government Press.) P.T. 6. [54

India Meteorological Department. Scientific Notes, Vol. 8, No. 84: A Statistical Analysis of the Monthly Rainfalls in the Amraoti District (Berar). By N. Rajagopalan. Pp. 9–16. (Delhi: Manager of Publications.) 5 annas; 6*d.* [54

U.S. Department of the Interior: Geological Survey. Bulletin 898–G: Spirit Leveling in Missouri. Part 7: Central Missouri, 1896–1938. Pp. ix+871–1004+xi–xiv+1 plate. 25 cents. Bulletin 898–H: Spirit Leveling in Missouri. Part 8: West-Central Missouri, 1896–1938. Pp. x+1005–1106+xi–xiv+1 plate. 20 cents. Bulletin 900–B: Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 2: Townships 22 and 23 North, Ranges 8 and 9 East. By C. T. Kirk, H. D. Jenkins, Otto Leatherock, W. R. Dillard, L. E. Kennedy and N. W. Bass. Pp. iv+47–82+plate 2. 40 cents. Bulletin 900–C: Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 3: Townships 24 and 25 North, Ranges 8 and 9 East. By N. W. Bass, L. E. Kennedy, J. N. Conley and J. H. Hengst. Pp. iv+83–129+plate 3. 40 cents. (Washington, D.C.: Government Printing Office.) [84

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BOOKS IN WAR-TIME

WILL books be made subject to the Sales Tax proposed by the Chancellor of the Exchequer, and if so what may be the results ? So far as can be ascertained up to the present it is not proposed to allow any exceptions in the home market, outside the domain of food and drink, and the resultant anxiety of all who are familiar with book-trade economics would undoubtedly be shared by every thinking man if the very special facts of the case were generally understood. In the following very brief survey of a very complex problem, it has been impossible to attempt more than the sketchiest of outlines, but it may be hoped that it will do something to correct some common misapprehensions and perhaps enlist some sympathy for the claim of books to special consideration. This claim has been emphatically put forward by the National Book Council, in an urgent call for action recently circulated to every society and association of a cultural nature.

To the printed book we owe the preservation of the philosophy, the scientific knowledge, the religion and the poetry of the past. Upon the book depends the comparative examination of rival theories, the precise record of all experimental work. In short, civilization as we know it to-day is the child of the printed word, and upon the printed word, written under the twin inspirations of intellectual freedom and love of truth, depends all hope of further progress.

Out of the almost universal recognition of these truisms there has arisen a tradition, never yet over-ridden in Great Britain, that a tax upon books would constitute an unfortunate impediment to free speech and a tax upon literature and learning. It is therefore not surprising to find that the National Book Council is exerting itself actively to organize, before it is too late, effective opposition to the proposition now under review. The National Book Council was founded in 1927 to promote the use and appreciation of books of all kinds, from the novel to the technical treatise, and the membership is open to all who care for books.

The letter to which reference has already been made was sent at the instance of this body's Consultative Committee, through which is maintained liaison with many of the most important educational bodies, learned societies and social organizations in the country.

In this Committee's manifesto, it is claimed that the application of a sales tax to books would be "inimical to the best interests of research, study and recreation", and that "in addition it would tend to disrupt still further the whole educational programme of the nation—a programme already suffering from disorders caused by the war". Let us examine this claim.

The Chancellor of the Exchequer, in introducing the principle of the sales tax, made it clear that its purpose is at least as much to discourage internal expenditure as to raise funds towards the successful prosecution of the War, and from this it is fair to assume that in the eyes of the Government books are to be regarded simply as a commodity, just like any other, the consumption of which must be discouraged as cheerfully as, perhaps, the luxury cosmetic or the unnecessary spare suit. This attitude, which is discouraging to all who deplore the widespread tendency to regard books as luxuries, cannot be allowed to pass unchallenged, if the nation is not to find itself without books, publishers to produce them or booksellers to sell them. Fortunately there is hope of persuading the Government that books have, quite apart from their cultural influence, a very considerable economic value to the nation at war, besides being absolutely essential to the presentation of the British case to the eye of ally and neutral.

In this connexion we cannot do better than quote the following paragraph from a "Memorandum on the Export of Books" submitted to the Export Council by the Publishers' Association: "The 'cultural' value of books is unique. The word 'cultural' does not at all adequately express what we have in mind and has narrow academic associations which we would gladly avoid. Nor is 'propagandist' a better word. What the book trade does, in general and apart from the particular purposes of particular books, is to publicize British habits, ideas and ideals over the entire world. It is consequently a continuing proof of the reality of the Allied Cause. The variety, vigour and freedom of British civilization are demonstrated through the whole range of its literary output, from the ordinary novel to the most serious critical and scientific works: and this continuous process cannot be allowed to flag without endangering British influence and prestige everywhere."

It has been repeatedly stressed that, for economic reasons, whatever happens to our internal trade, neither the proposed sales tax nor any other war-time legislation should interfere with British export trade. But apparently it is not realized that books, unlike most commodities or manufactured products, cannot be divided up into two water-tight compartments—home and export. The largest part of a book's production cost is the cost of setting up the type, and as this remains the same whether it is to be printed by the hundred or the thousand, it is clear that the largest possible circulation must be aimed at if the price is to be kept at an economic level. Another large fixed expense is the cost of placing the type on the printing machine and of 'making ready' for printing, a skilled and laborious job which is carried out by highly paid craftsmen. By the influence of these two factors is to be explained a large part of the price differences between newly printed books at 7*s.* 6*d.* and more, cheap editions and reprints from standing type at 3*s.* 6*d.* to 1*s.* 6*d.*, and "Penguins" at 6*d.* each which, though completely reset, spread the cost over editions of thirty to fifty thousand.

This being so, it is clear that if attractive price-levels are to be maintained in the export markets, the maximum home demand must be encouraged. If the home demand is artificially cut down editions will shrink, and prices will rise so sharply as to destroy the potential demand abroad and make impossible the publication of many books of the first importance. There are unfortunately no reliable statistics in the book trade, but a recently circulated *questionnaire* has shown not only that at least one third of the total book production of Great Britain is sold abroad, but that, in addition, valuable invisible exports are created by the sale of American film rights. If we add to this consideration the claim that the export of British books does much to unite the Empire, to demonstrate the British outlook and ideals all over the world and, incidentally, to prepare the way for the exporters of other British goods, we may reasonably conclude that its importance to the nation is out of all proportion to its monetary value.

It will be generally agreed that on cultural grounds alone, book prices should be maintained within a reasonable distance of pre-War levels. Unfortunately this aim becomes increasingly difficult of achievement, and it seems likely that the strenuous efforts to stabilize prices, which maintained them at pre-War level for the first three months of the War, will be utterly defeated by the situation in Scandinavia. An important factor in price fixing is the cost of paper, and the cheaper the book the more relatively important does this factor become. At the onset of the War, the Government took over the control of all paper supplies. A controller was appointed and a schedule of maximum prices was worked out, promptly imposed, and linked to a drastic rationing scheme which reduced the nation's consumption to 60 per cent of pre-War requirements. This restriction, combined with a heavy percentage increase in the price of paper, had already forced up the price of the standard cheap editions and of many, but not all, of the new spring books, when the Germans invaded Norway and attained the control of the Skagerrak by the occupation of Denmark.

The larger part of the wood pulp supplies which form the basis for most of our paper was cut off at a stroke and no one knows when, or if, it will be available again. The result was immediate and startling. A further increase in prices coincided with a 50 per cent cut in permitted consumption, and this was followed by an announcement that after the current licensing period a further severe cut in consumption, possibly up to another 50 per cent, will be necessary. At the time of writing, therefore, the book trade is wondering what it can usefully do with 15 per cent of its pre-War paper consumption, at prices more than 60 per cent above pre-War levels.

With wages, rates and fuel costs rising in competition, with compulsory war risks insurance to pay, and with the problems of evacuation to contend with, the situation was already critical for bookseller and publisher alike. Increased production costs call for 'longer runs', but such a scarcity of material will not only make this impossible but also will necessitate, on the contrary, much smaller editions than usual. It is difficult therefore to see how publishers will be able to avoid for much longer a dangerous increase in price-levels at a time when Government policy is to prevent general inflation and, by taxation, both direct and indirect, to limit internal expenditure. Already, we believe, the sale of new fiction and general literature has dwindled to a fraction of its pre-War volume, but the demand for books on the War and international politics, official Blue Books, memoranda and handbooks, together with standard cheap editions of the classics, old favourites and popular reference books, has gone far to cancel out the drastic effect of the evacuation in London and other evacuation areas, while elsewhere business has been quite brisk. But the War has scarcely begun, paper shortage has only just begun to take effect, and the real price increases are not yet upon us, though close at hand. The outlook of the immediate future, so far as book production is concerned, is gloomy in the extreme.

To this situation is now added the threat of a sales tax which may be anything from 5 to 25 per cent on to prices which by then will already have risen. Such an impost would be a veritable tax on literature and culture. Books are often the first objects of personal economy, and this can unfortunately also be said with equal truth of the councils and committees of local government and public education. Even in peace-time conditions expenditure per head on books in Great Britain is very much below that which is accepted as normal to the Finns, the Germans the Scandinavians or the French. As has been said, no statistics exist, but it has been possible to make approximate estimates within a generous margin of error, and as a typical illustration it may be of interest to recall that according to the estimate of the Consultative Committee on Books in Public and Elementary Schools which reported to the Board of Education in 1928, the average annual expenditure on books, per head, was certainly not in excess of 1*s.* 8*d.*, and it has not shown much sign of improvement since that date.

Were there greater mental alertness and intellectual curiosity, books would be able to perform adequately the service which they now offer too often in vain, and their producers would be able to supply, at prices within the range of every pocket, new works of literature, of learning and of reference which at present are confined to the shelves of the libraries and the dwindling regiment of the bibliophiles. It is to extend and develop this wider interest in, and appreciation of, books that the National Book Council was formed.

The production of books is authoritatively stated to consume only 2 per cent of the nation's normal paper supplies, and a reversion to the earlier allowance of 60 per cent of normal, which would enable the publishers to carry on with reasonable efficiency, would therefore call for the re-allocation of about 1 per cent of the nation's pre-War supplies. In practice, by careful selection and economy in production, it would probably be possible for the book trade to carry out its important functions on an even lower allowance; but precisely how much this would be is probably best left to the Publishers' Association.

The present international crisis threatens to bear with undue weight on book production. Learned and educational organizations may be expected to give active support to the appeal for special consideration for books. If disaster to the intellectual life and the intelligent recreation of the nation is to be avoided, books should be exempted from the sales tax and accorded a wholly disproportionate share of the available supplies of their raw material—paper.

Long-range planning is a necessity in book-production as in many other fields, and without an early pronouncement on the position, an important part of the nation's effort is being held up. The case appears to be so strong that the urgent representations now being made can, one may hope, scarcely fail to have their effect. But the desired result will be more quickly and more completely attained if all those who realize the place of books in the social, intellectual and economic fabric of the nation use their influence wherever it may be most effectively applied.

DESCRIPTIVE AND PREDICTIVE SCIENCE

Science To-day and To-morrow
By Waldemar Kaempffert. Pp. 262. (London: Ivor Nicholson and Watson, Ltd., 1940.) 10*s*. 6*d*. net.

MUCH more is done in the United States than in Great Britain to interest the general public in scientific progress. Nearly twenty years ago, the late Mr. E. W. Scripps, a newspaper proprietor and editor, provided a sum of more than 100,000 dollars to establish the organization called Science Service, with a staff of competent writers who simplify and illuminate scientific news for the public Press; and newspapers in all parts of the country are subscribers to this service. Many of the leading newspapers have, in addition, permanent members of their editorial staffs to describe and comment upon scientific matters. Dr. Kaempffert, the author of this book, occupies an honoured position of this kind, as science editor of the *New York Times*; and his contributions are widely read and appreciated. Some of the material in the book appeared originally in that newspaper and other magazines; and all of it represents the reactions of an informed and thoughtful mind to the results of scientific investigations in the realm of natural knowledge.

Each of the eighteen chapters can be read and understood independently of what precedes or follows it, though the general arrangement seems to represent successive aspects of the heavens, terrestrial forms of matter, life, man and the machine. Under the title, "A Star Explodes", the first chapter deals with modern observations of new stars and presents views held by leading authorities as to their origin and nature. There are reasons for believing that, in the course of their existence, most stars are likely to have immense stores of energy suddenly released by the near approach of another body or by conditions of internal instability. The planets of the solar system were formed from streamers drawn out of the sun by the gravitational influence of a passing mass; and a similar explosion may be caused in the distant to-morrow by another approach or by changes of atomic structure. Either of these events would mean the end of the earth and the possible beginning of a new world—organic as well as inorganic. The end of the sun as we know it is inevitable, whether by celestial accident or by loss of radiation through atomic changes discussed in the succeeding chapter; and "man will be blotted out by forces that were hostile to him from the beginning of time and over which he triumphed for a brief hour".

The next chapter, entitled "Birth and Death of the Moon", is a short outline of the theory of tidal evolution applied to our satellite, ending in its near approach to the earth, the consequences of which are catastrophic changes in the crust, while great fragments of lunar mountains fall upon the surface or revolve around the earth as a ring of meteorites which are met so frequently that our globe becomes a blackened and dead world drifting through space. The curtain falls on the death of mankind as the result of all these celestial events; and, after bringing together in another chapter what has been revealed in recent years as to the atmospheres and constitutions of the planets, "it seems as if only the earth is capable of supporting the highest forms of life—for the one freakish world in a freakish solar system." Copernicus deposed the earth from its place in the centre of the universe which the presumption of man had given it; astronomy now suggests that both it and mankind are consequences of a series of accidental circumstances.

It must not be supposed, however, that Dr. Kaempffert, like Joe, the fat boy in "Pickwick Papers", "wants to make your flesh creep" by confining himself to forecasts of man's terrestrial destiny suggested by modern astronomical knowledge. Man has already devised artificial means of maintaining human life under unnatural conditions. In his hermetically sealed gondola, Piccard lived for a few hours and made new observations of the earth's atmosphere at altitudes never before attained by a human being; and by his ascent he became the first of a new type of explorers. Science of to-morrow may enable the journeys to be extended until it becomes possible for man to be shot off or rocketted through space to such a planet as Venus, which by that time may be adaptable to human habitation. Meanwhile, science to-day is accumulating much new knowledge of the nature and conditions of the upper air and beyond, and Dr. Kaempffert traces these developments from the explorations of Teisserenc de Bort to the present time.

It is through such investigations that we may hope to obtain further information as to the origin of cosmic rays and their relation to atomic processes. A good chapter is devoted to modern work on the physics of the atom; and we read, "Out of atom-bombarding, out of the intellectual effort to explain what the atom is, comes a new, profound, and stirring conception of the universe and our place in it".

Such are the subjects and general outlook of the first seven chapters of the book. The position and prospects of the subjects of the remaining eleven chapters are similarly treated. It is sufficient here to say that these chapters are concerned with the passing of the Coal Age and the possible uses of other sources of energy; achievements of synthetic chemistry; the creation of living organisms; cell structure in relation to processes of organic evolution; Alexis Carrel's work on tissue culture and the uses of Lindbergh's perfusion pump; transient man and his reactions; lightning and other high-tension discharges; mechanical aspects of the attainment of speed (H. E. Wimperis's British Association address on "The Future of Flying", at Dundee last August, could have provided some striking points for this chapter); internal mechanism of the *Queen Mary*; the calling up of personalities of the past or present through radio and television and the preservation of sense impressions; and the relationships of science to social evolution.

Dr. Kaempffert's main aim has been to present important aspects of scientific work and thought to an intelligent public; and to suggest some of their social consequences or implications. In his forecasts of events or possibilities which will influence the future of the earth and mankind, he rarely goes beyond what some scientific men themselves have fancied may happen; and he cannot, therefore, be accused of ministering to scientific sensationalism. Almost every one of his chapters provides the basic material for an imaginative scientific fantasy or romance; and Mr. H. G. Wells, the master of such literature, has already exercised his genius in the production of many absorbing stories of this type. Dr. Kaempffert may be said to occupy a place between the purely descriptive writer, who is making scientific knowledge interesting and intelligible to general readers, and the man of letters, who occasionally lets his mind play upon the potentialities of discoveries made in scientific fields. His work is an excellent example of what can be done to educate the public in the spirit of science and the human meaning of the results achieved.

R. A. GREGORY.

THE LOUSE AND LOUSE-BORN DISEASES

The Louse
An Account of the Lice which Infest Man, their Medical Importance and Control. By Prof. Patrick A. Buxton. Pp. ix+115. (London: Edward Arnold and Co., 1939.) 7*s*. 6*d*. net.

THE louse of man, *Pediculus humanus*, is concerned with the transmission of the micro-organisms of at least three of his diseases. From the medical point of view, therefore, it is a creature of importance and especially during periods of war. The most virulent of these diseases is epidemic typhus which, in Europe, occurs in the U.S.S.R., the Balkans and many parts of the Mediterranean region. In recent years it has steadily receded and disappeared not only from England and Wales but also from western Europe. It is noteworthy that it did not break out on the Western Front during 1914–18, notwithstanding the virulent epidemics that prevailed in Serbia during that period. The second louse-borne disease is trench fever which, it will be recollected, was so prevalent in the armies of the Great War. Yet, when that calamity ended, the disease vanished from western Europe while the louse still remains. Relapsing fever is the third louse-borne malady and is widely distributed in eastern Europe, where epidemics prevailed during the years 1914–18.

In the present crisis the louse problem is likely to force itself once more into prominence. We need to go beyond existing empirical methods of delousing: to deter infestation is a possibility of prime significance. The disappearance of trench fever at the end of the War of 1914–18 stopped further inquiry. Whether infection is solely by means of the entry of the virus, in the dried fæces of the louse, through scratches or abrasions, or perhaps via the conjunctiva and respiratory tracts also, needs renewed inquiry. The curious feature seems to be that Pediculus does not generally convey any of the three diseases named by means of its blood-sucking mouthparts. It is evident that while knowledge of the louse and its economy has greatly increased during and since the War of 1914–18, certain essential information still remains a desideratum.

Dr. P. A. Buxton in his handbook has given an accurate and concise summary of our present knowledge of both Pediculus and Phthirus together with methods for their control. Originally written as part of a larger work on medical entomology, which is in preparation, the importance of the subject in civil and military life at the present time led the author to publish this section in advance. The army medical officer, in particular, should have this convenient little manual available, since it provides a clear exposition of aspects of the subject likely to be overlooked and indicates where further inquiry is needed.

A. D. IMMS.

ECONOMIC WARFARE

(1) Economic Warfare
By Paul Einzig. Pp. x+151. (London: Macmillan and Co., Ltd., 1940.) 7*s*. 6*d*. net.

(2) The Economic Effort of War
By R. W. B. Clarke. Pp. 252. (London: George Allen and Unwin, Ltd., 1940.) 7*s*. 6*d*. net.

THE volume of informed criticism of the Government's economic policy and the continued pressure for the inclusion in the Cabinet of a Minister for Economic Affairs, which were in no way dispelled by the speeches of the Prime Minister or the Chancellor of the Exchequer in the recent debate on economic organization in the House of Commons, indicate that there is a far more widespread appreciation of the importance of economic questions at the outset of the present War than at almost any time during the struggle of 1914–18. This difference is brought out strikingly in the early chapters of Dr. Einzig's book, and the existence of such interest and informed opinion make the more regrettable the failure of the Government to take the public into its confidence, to explain what is happening and to enlist its co-operation.

To some extent, what the Government failed to do is being done by an admirable series of pamphlets and books on economic questions of the War. The Oxford series of pamphlets on world affairs have included lucid expositions by Geoffrey Crowther of the economic and financial aspects of our war effort. The same aspects have also been discussed in a number of broadsheets issued by Political and Economic Planning (P E P), and Dr. Einzig's volume is a more detailed but no less lucid exposition of these matters, more particularly with reference to the use of economic policy and methods in pursuance of our war objective. If the reader couples with this volume, for example, a study of Mr. R. W. B. Clarke's "The Economic Effort of War", he could scarcely be better equipped to appreciate the significance of the economic factor or exactly what is required of him in the way of intelligent co-operation as a citizen. The Government should be grateful for the invaluable contribution which both these books make towards the education of public opinion and the preparation of the citizen alike for the contribution and the sacrifices which the prosecution of our war effort inevitably entails.

(1) Dr. Einzig does not exaggerate the importance of the economic factor and of economic warfare. While economic factors are likely to play a very important part in determining the outcome of this War, they can only produce their full effect in conjunction with military, naval and air force operations, and in his realistic analysis of the situation he emphasizes the necessity to prepare for a prolonged struggle. In regard to productive capacity, he stresses the importance from the outset of taking steps to increase the production of those goods which are required directly or indirectly for national defence purposes or are essential for the maintenance of the civil population, as well as to reduce or stop the production of non-essential or luxury goods, even if they only interfere with the increase of production of essential materials. Stress is also laid on the collection of statistical material as a basis for reorganization to enable national production to replace imports as far as possible.

The Government is criticized by Dr. Einzig for not taking adequate measures in some such fields, notably in regard to agriculture, prior to the outbreak of the War, but pays tribute to the rapidity with which emergency legislation was adopted within a few weeks of the outbreak of the War. After examining problems of production, distribution and consumption, foreign trade, public finance and foreign exchange he proceeds to discuss the methods of economic warfare and the war economy of Germany, France, Japan, the Soviet Union and the United States, as well as of Italy, before reaching his emphatic but reasoned conclusions that the superiority of the economic resources at the disposal of the Allies compared with those of Germany will in the long run be of decisive importance.

Dr. Einzig is under no illusion as to the intensity of the effort or sacrifices involved. He advocates ruthless rationalization, for example, and strong measures against luxury consumption, and he is prepared to support both industrial conscription and the conscription of labour. In this he differs from Mr. Clarke, who considers that from the military point of view, or that of public morale or increasing output and efficiency, it would be a mistake to try to impose industrial conscription at the present time. Mr. Clarke stresses the important contribution which the trade unions have to make to the national effort, and the necessity of enlisting that co-operation freely.

Dr. Einzig is, indeed, on the whole less critical of the Government effort than Mr. Clarke, though no less bold in his outlook or suggestions. His criticism is indirect or implied rather than direct, whereas Mr. Clarke's two chapters on Government control and the first six weeks of the War are among the most valuable in his book and should be of special interest to scientific workers. Their constructive criticism affords one of the best presentations of the argument for Cabinet reconstruction and the necessity of a Ministry of Economic Planning with its appropriate General Staff that has yet appeared.

Both these books should, in fact, be widely and appreciatively read, and should, as already indicated, assist in that educational work indispensable in our war effort, which the Government itself has largely neglected. It may well be hoped that their constructive criticism and suggestions—Dr. Einzig makes a shrewd comment and suggestion regarding economic propaganda and its use to undermine German economic morale which it is to be hoped will not fall on deaf ears—will be duly weighed by the Government as well as the general public. At least it is certain that these excellent contributions to the growing mass of useful literature on the economic side of the War will contribute to the rapid formation of a public opinion which will render it impossible for the Government to continue its hand-to-mouth policy and attitude of drift in economic matters. They should force upon it the coherent policy, planning and organization which form the indispensable basis for that drastic limitation of non-essentials, comprehensive mobilization of industrial resources and vigorous prosecution of every aspect of economic warfare which are essential to the success of our war effort.

R. Brightman.

THE INDIAN FRAGMENT OF GONDWANALAND

Regionale Geologie der Erde
Herausgegeben von Karl Andrée, H. A. Brouwer und W. H. Bucher. Band 1, Abschnitt 6: The Indian Peninsula and Ceylon, by G. de P. Cotter. Pp. 66+vi. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.)

Dr. G. de P. Cotter, until recently a superintendent of the Geological Survey of India, has utilized the experience of a lifetime spent in the field in India in summarizing the present state of knowledge of the geology of the peninsula. There are no Palæozoic rocks there older than the Talchir Boulder Bed at the base of the Gondwanas, which is regarded, with fair confidence, as Upper Carboniferous. The glaciation was more intense in the south, where ice-scratched rockfloors and boulders occur, whereas in the Himalayas (in Spiti and Kashmir) the representative of the Boulder Bed is a basal conglomerate which may have been deposited by floating bergs. Since India is the only land north of the equator where the Boulder Bed occurs, Cotter is inclined to accept the hypothesis of continental drift and to regard the Indian fragment of Gondwanaland as having drifted northwards from its original home south of the equator, leaving behind it portions of its mass in Madagascar, the Chagos archipelago and the submerged land which forms the platform of the Maldives and Laccadives. Elsewhere the latter is regarded as the extension of the Aravalli Range.

The impact of this great land mass with the "northern continent" occurred, according to Cotter, in the close of the Cretaceous, and is associated with the outpouring of the Deccan Lavas now assigned definitely to the Danian. Incidentally, the evidence is steadily growing that the folding of the Indo-Malayan mountains and the intrusion of the tin-bearing granites of Burma and Malaya are of the same age. Further drifting of the land mass helped in Tertiary times to build the Himalayas and to elevate Eocene marine rocks to heights of more than 20,000 feet.

Cotter accepts the work of Spath on the cephalopods from Upper Gondwana beds of the Madras coast. These beds, once claimed by Waagen as Neocomian but long since regarded on the evidence of plant remains as Middle Jurassic, are now classed as Upper Neocomian, possibly Aptian, so that the Upper Gondwanas range in age from Upper Trias to Aptian, most of Jurassic time being represented by a stratigraphical break.

Most of the book is naturally devoted to the Pre-Cambrian—falling into the two great groups, the Purana or Algonkian and the Archæan. The Purana as a whole are unaltered sediments and in the Peninsula generally horizontal or only slightly disturbed, but in the Aravalli Range there was marked folding in Middle Purana times. The threefold division of the Puranas is into Lower (Cuddapahis and Delhis), Middle (Lower Vindhyans) and Upper (Upper Vindhyans and Karnuls). Cotter admits the many problems still unsolved in the geology of the Archæans but regards as definite that the Bundelkhand gneisses, Singhbuhm metamorphics and Berach granites (Group I) are the oldest rocks of the country; that the Closepet Granite, Charnockites (Group V) and Peninsular or Foliated Gneisses (Group IV) are newer than the metamorphosed sediments (including the Dharwars and Aravallis, Groups II and III) with which they are associated.

L. Dudley Stamp.

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

TWENTY-FIFTH ANNIVERSARY

WHEN Mr. J. A. Pease, the then president of the Board of Education, in introducing the Board of Education estimates in the House of Commons on May 13, 1915, announced the impending appointment of an Advisory Council for industrial research in Great Britain, to be specially entrusted with the supervision and encouragement of scientific research particularly in relation to industry, he laid special stress on the importance of providing for the training of the scientific and technical personnel. Already the early months of the War of 1914–18 had revealed the dangers and difficulties in which Great Britain was placed through the neglect of science by industry and the absence of an adequate scientific personnel. We had not merely to make the best use of the scientific men we then possessed, but also to provide a further supply in the future. The debates in the House of Commons on the proposals eventually issued by Mr. Pease's successor at the Board of Education, Mr. Arthur Henderson, in a White Paper (Cmd. 8005), as in the original statement, thoroughly endorsed the Government's proposal to deal with this problem as an integral part of a comprehensive improvement in our educational system. It was indeed originally proposed that the whole scheme should be supervised by the Board of Education, to which the expenditure of £1,000,000 over a period of five years would be entrusted on the advice of the proposed Central Council of Commercial and Industrial Research.

The reports of these debates reveal after twenty-five years the immense debt of the nation to those whose vision and courage launched this venture even in the days of war. That the outbreak of war in September of last year found Great Britain with resources in scientific and technical personnel adequate to meet all demands is due in no small measure to the foresight and energy of such men as Lord Haldane, Lord Balfour and Dr. Addison, and the wise guidance of such successive chairmen of the Advisory Council as Sir William McCormick and Lord Rutherford. Whatever concern may have been expressed as to the use which is being made of available scientific personnel or resources, except perhaps in a few fields such as those of the social sciences, the ability of the scientific workers and the research organization of the country to meet whatever demands may be made upon them by the War is beyond question. Even before the War of 1914–18, scientific workers in Great Britain, if few in number compared with those of some other countries, had many outstanding achievements to their credit and were playing their full part in scientific advance. For the great advance in the numbers of British workers, and unprecedented expansion in the application of scientific research in industry and in every phase of national life in the last quarter of a century, without any impairment of that capacity, no small share of the credit must be given to the Advisory Council of Scientific and Industrial Research, first established by Order in Council on July 28, 1915.

The White Paper which outlined the scheme alluded to the difficulties in which many of our industries had been placed in 1914–15 through our inability to produce at home certain articles and materials required in trade processes, the manufacture of which had become localized abroad, because science had there been applied more thoroughly and effectively to the solution of scientific problems bearing on trade and industry and to the elaboration of economical and improved processes of manufacture. To advance or even maintain our industrial position it was essential to aim at such a development of scientific and industrial research as would place us in a position to expand and strengthen our industries and to compete successfully with the most highly organized of our rivals. The scheme was designed to establish a permanent Department for the promotion of industrial and scientific research.

For this purpose a Committee of the Privy Council was set up, responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research, and an Advisory Council, responsible to the Committee of Council, and composed mainly of eminent scientific men engaged in industries dependent on scientific research. The prime functions of the Advisory Council were and are to advise the Committee of Council on proposals for instituting specific researches, or for establishing or developing special institutions or departments of existing institutions, for the scientific study of problems affecting particular industries and trades, and on the establishment or award of research scholarships or fellowships. The Advisory Council is also available to advise the education departments as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

The Advisory Council, which met for the first time on August 17, 1915, was further directed to frame a programme for its own guidance in recommending proposals for research and for the guidance for the Committee in Council in allocating such State funds as might be available, designed in advance to operate over some years, having regard to the relative urgency of the problems requiring solution, the supply of trained investigators available, and facilities in laboratories or equipment which could be provided. The method of approach adopted by the Council is indicated in its first report. The Council was under no misapprehension as to the relation between pure and applied science. It was decided to give science in its application to industry precedence over pure science in the Council's deliberations, and after a period of careful inquiry and consultation to initiate a gradual and systematic attack upon a wide and carefully selected front.

The soundness of the policy and principles outlined in the first report of the Advisory Council is attested by the results which have followed from these modest beginnings. Realizing from the start the dependence of the success of its work upon a greatly increased supply of research workers and upon a hearty spirit of co-operation among all concerned, whether scientific workers, business men, professional and scientific societies, universities and technical colleges, local authorities and Government departments, it was recognized also that neither condition would be effective alone. The first condition of success was at the start unattainable, and even at the end of the War of 1914–18 the number of trained research workers was insufficient for the demand. Effective research, particularly in its industrial application, calls increasingly for the support and impetus that come from the systematic team-work of investigators of mediocre ability, working intelligently under the direction of first-class leaders.

The problem of the supply of investigators of the requisite abilities in sufficient number is largely a matter for the education departments. It is not entirely a matter of the provision of scholarships, but depends also on the standard of students entering the universities. None the less, in the first ten years, as the report of the Advisory Council for the year 1925–26 shows, much was done to re-establish a body of scientific workers of the highest rank for purely scientific work, and to enable men who intended to make some branch of industry their profession to equip themselves for scientific work in industry by postgraduate research work.

Of the seven hundred allowances given in the first seven years, nearly four hundred were to students of chemistry, and in its report the Advisory Council expressed the opinion that too many men were encouraged to specialize in chemistry. The records of the Department showed that large numbers of applications were received whenever a post for chemical research was advertised, while the demand for men who combined a study of chemistry with other subjects such as agriculture, biochemistry or botany outstripped the supply. There was also a scarcity of men interested in, and capable of, the application of general physics in industry, a position which has hardly been improved in the subsequent fifteen years, as the experience of the Central Register indicates. Although the proportion of grants held by students in training in biology has steadily increased in recent years, and has for some years been equal to or greater than those held by students in physics, students of chemistry have consistently been at least twice as numerous as those of students in any other branch of science in receipt of grants.

The service which the Department of Scientific and Industrial Research has rendered to the development of pure science is far from being limited to the provision of maintenance allowances for students or even special assistance to independent research workers, whether by helping young research workers of exceptional ability to pursue their work for a limited period without the necessity of finding other employment, by the provision of funds for research or technical assistants or the purchase of special apparatus and equipment, or, in special circumstances, by making really substantial grants. The Advisory Council has consistently shown in its reports a wise concern for the conditions of employment of the research worker, whether in regard to salary or security of tenure ; this is a contribution to the raising of standards in the last two decades which has earned the cordial appreciation of all scientific workers.

In regard to the actual prosecution of research, the record of the twenty-five years work of the Department makes impressive reading. It includes the development and expansion of such institutions as the National Physical Laboratory and the Geological Survey and Museum of Practical Geology, which were already in existence and were taken over by the Department. It includes the establishment of the Fuel Research Station at Greenwich, the Building Research Station at Watford, the laboratories of the Food Investigation Board at Cambridge, East Malling, Chipping Campden and Torry, the Forest Products Research Laboratory at Princes Risborough, the Radio Research Station at Slough, the Chemical Research Laboratory at Teddington, and the Road Research Station at Harmondsworth.

At these stations and under the direction of the various boards or committees of the Department, research has been initiated on a national scale into such fields as fuels, forest products, food, water pollution, transport problems. Simultaneously, through the co-ordinating boards set up in 1920, the research departments of the Fighting Services have not only been placed on a secure footing but also brought into effective contact with the work of the Department. Medical research and agricultural research have also expanded considerably in the period, often in co-operation with the work of the Department, while in 1925 there was formed the Committee of Civil Research to advise on broad questions of national policy involving scientific and industrial research on much the same lines as the Committee of Imperial Defence.

Besides all this co-ordination of existing organizations and initiation of fresh lines of work, the Department has done much to stimulate research on questions of interest to the Dominions and Colonies, and to secure co-ordination with the corresponding departments formed overseas, such as the Council for Scientific and Industrial Research of the Commonwealth of Australia, the Department of Scientific and Industrial Research of New Zealand, or the National Research Council of Canada, notably in investigations on food problems or such matters as Empire timber. In such imperial problems and in the more domestic problems of Great Britain, the Department has succeeded in promoting co-operation between the different interests concerned, whether consumers, manufacturers, Government departments or others in the attack on common problems.

To the extent of that co-operation the development of the research association movement in Great Britain bears emphatic witness. On December 1, 1916, in receiving a deputation of the Board of Scientific Societies, Lord Crewe, as Lord President of the Council, announced the intention of the Government to ask Parliament to place a million pounds at the disposal of the Department to enable it to co-operate with the industries of the country in the foundation and maintenance of approved associations for research during the following five years or more. This fund was duly voted by Parliament and became available in July 1917; the scheme had been outlined in detail in a paper issued by the Department in June 1917. The scheme visualized the systematic development of research and the co-operation of science with industry carried out under the direct control of the industries themselves. In this way it was hoped to avoid the danger that, if the work were done by the State or the universities, the results would not be put into immediate operation, and as they would necessarily be published, might become of equal or greater benefit to foreign competitors. Moreover, it was hoped that co-operation of the firms engaged in any one industry might enable research work to be undertaken which could not have been dealt with by a single firm.

The rapid progress made under the scheme was indicated in the excellent account issued in 1927 under the title "Co-operative Industrial Research", and when on the exhaustion of the Million Fund the Advisory Council devoted the greater part of its annual report for the year 1932–33 to a review of the scheme, it was able to point to important practical achievements as well as to evidence that the scheme had contributed to a definite acceleration in the advance of industrial science. The first four associations were licensed by the Board of Trade under the scheme in 1918, followed by ten more in 1917, nine in 1920 and one each in 1921, 1923, 1930, 1937 and 1938; two more were formed in 1926, as well as similar organizations in 1929 and 1931, though not of the same formal and legal status, by the National Federation of Iron and Steel Manufacturers and the Institution of Automobile Engineers.

Certain of the associations never became effective, and some after several years active work ceased to operate or became merged in other bodies fulfilling similar functions. The last report of the Department shows, however, that there are still twenty-two research associations in existence, serving a very wide range of industries, and achievements to their credit already offset very largely the expenses of their work. For example, it has been computed that, in the first ten years of its work, the researches of the Electrical Research Association on insulating oils, costing £8,500, had involved savings to the industry of at least £100,000 a year. Further researches on buried cables, costing £18,000, had represented a saving to the industry of at least £250,000 per annum and added four millions to the value of the existing cables. Investigations of the British Cast Iron Research Association, if fully adopted, would result in the saving of fuel and other economies of £200,000 per annum. Almost equally striking savings have resulted from investigations conducted by the Non-Ferrous Metals Research Association on ternary lead alloys used in sheathing cables and for water-pipe service, and by the Refractories Research Association on prolonging the life of saggars.

The significance of such achievements in the present urgent need for national economy in every sphere is obvious, but too much stress should not be laid on such concrete examples. Often it is difficult to assess at all accurately either the direct or the indirect results of such research in stimulating a scientific approach to industrial problems and the application of scientific knowledge in industry. The Advisory Council has from the start been alive to the importance of securing not merely the initiation of industrial or scientific research but also the utilization of its results by industry. "One of our most important tasks", wrote Lord Rutherford in the 1935–36 report, "is so to organize the conduct of research as to promote contact with industry", and this is one of the main reasons for attaching so much importance to the development of the research association movement. The application and development of scientific ideas in industry depend upon a complete understanding of the way in which industry can make use of science and scientific method.

So far back as its 1930–31 report, the Advisory Council noted the extent to which the time of the staff of a research association was occupied in work for the firms which constitute it and in visits to works, thus functioning as the 'general staff' of the industry ; further, increasing attention has been given to the presentation of the industrial and financial implications of scientific data in publications so as to facilitate their utilization on a wide scale in industry.

However admirable the results achieved by many of the research associations, the movement has been open to criticism on account of the inadequate scale on which it has been financed. Moreover, the success which has attended the scheme of block grants which was initiated as a result of a review of the situation during 1933–34 and later discussions with the various associations should not lead us to overlook the fact that, although the total sum subscribed by industry has increased by forty per cent to more than a quarter of a million pounds per annum since the scheme came into operation, there are still associations receiving insufficient financial support from the industry to qualify for the block grant.

Important as the research association movement may be, it provides only one example of the way in which the work of the Department has led to increasing value being placed upon research by the leaders of industry. An admirable example of the way in which progress has been made in gaining the confidence of industry is provided by the work of the Water Pollution Research Board, the youngest of the major research activities of the Department, notably in relation to the disposal first of polluting waste waters from the beet sugar industry and later in the treatment and disposal of effluent from dairies and the manufacture of milk products. The developments referred to in the last report of the Advisory Council in relation to the testing of electrical switchgear by the National Physical Laboratory provide a further example of this tendency, while equally striking illustrations might be found in such fields as the testing or specification of building elements for their resistance to fire, or the work of the Building Research Station or Steel Structures Research Committee in co-operation with various branches of industry. The importance of the work of the Building Research Board of the Department in securing the most economical use of all building materials in war-time need scarcely be further stressed, whether in view of the magnitude of the Government's building programme alone, which for 1940 is estimated to cost about £200,000,000, chiefly for aerodromes, storage depots, and factories, or with regard to the necessity for conserving to the utmost our resources of steel and timber and reducing imports. Dr. E. V. Appleton, the present secretary to the Department, recently indicated that adoption of the Board's recommendations would permit substantial economies in timber and steel, and special arrangements have been made by the Government for dealing with the technical problems of building created by the War.

The research work which the Department itself has developed in the national interest has in general been that required to deal with such primary needs of man as his food, fuel, building, the use of timber and the protection of his drinking water or the atmosphere from pollution. The impressive review given in last year's report of the Advisory Council of the twenty years work of the Food Investigation Board shows how important are the advances which have flowed from work initiated in 1917 in face of the serious shortage of food then existing. It is difficult indeed to assess the importance to our war effort of the increased knowledge gained in regard to the storage and transport of food of all classes. Victory might indeed turn on the elimination of waste in this manner by the preservation of existing stores or supplies from damage by disease or pests, but it may equally depend on the further increase in our resources coming from more effective utilization, through the Department, of the resources and knowledge already available for the elaboration and execution of a sound policy of food production and supply.

Great as have been the achievements of the Department and admirable the work of its numerous research stations, boards or sections, the nation cannot rest content with what has already been done. There are still industries which suffer from the absence of scientific direction and failure either to prosecute research or utilize existing scientific knowledge. Five years ago, the Advisory Council wrote in its report: "The scientific outlook of these industries leaves much to be desired. Neither in the directorates nor among the technical and executive staffs is sufficient weight yet given to scientific attainment and experience, and until a radical change has taken place in this respect the position is bound to be that the industries as a whole will remain unable to obtain the full benefit of the results of scientific investigation." The scale upon which research is organized, and even its extent in Great Britain, still compare unfavourably with that in some of its competitors, and it cannot yet be contended that with all the advances of the past twenty-five years the value of scientific research and its contribution to industrial progress or national welfare is generally appreciated either by the general public or by the Government.

The increased attention which is now being given to the general structure of the organization of research in Great Britain itself shows that the work of education has progressed. The twenty-five years' work of the Department will be considered not by itself but in relation to the research proceeding in industry, at the universities, and under more direct Government auspices, such as through the Agricultural Research Council or the Medical Research Council. If the expansion still required for the full service of the needs of individual industries or of national needs is to be secured, more than additional financial resources is required. There is still need for close co-ordination of existing effort, and for the re-distribution of available resources, whether of personnel or equipment. The lack of proportion between scientific advance in different fields is a handicap which requires correction and involves further attention to our educational system, possibly by more fundamental methods than the distribution of grants to students or research workers. Progress here depends on the education both of public opinion and of the administrator. We may well hope that, in glancing over the twenty-five years' work of the Department of Scientific and Industrial Research, scientific workers may be led to take a further part in that task of education and give firmer and more united support to the elaboration of a national policy and programme of scientific and industrial research which will serve the nation's changing and growing needs, whether in peace or war, on a more adequate scale.

SCIENCE IN THE ROYAL ACADEMY, 1940

BY LIEUT. W. E. SWINTON, R.N.V.R.

THE one hundred and seventy-second exhibition of the Royal Academy of Arts, which opened on May 6, is a typical "Royal Academy". That is to say, it is conservative and consists of the same kind of interesting, promising, or sometimes even satisfying works largely by the usual artists. Its subjects for the most part are retrospective, concerned with the personalities and events of the past rather than reflecting the tendencies and affairs of the present. It is therefore natural that the general tendency of the works is to portray the splendours of the seasons and those rural and coastal charms accessible to the country cottage rather than the stirring, if unpleasant, realities that confront us now. Artistic licence, however, like that of the poets, stipulates no adherence to the apparently stupendous events of the day, a fact which may explain why art is more enduring than the news-sheet.

There are, of course, a few works devoted to the more spectacular events of the last few months. Of these, pride of place goes to Norman Wilkinson's "River Plate Action", an inspiring representation based on the account given by Captain Woodhouse, R.N., and the same artist's "Air Battle, December 18th, 1939", painted from a description given by the leader of the formation. The *Altmark* incident is recalled by "The Stranded Prison-ship", by Charles Gere, R.A. "The Convoy and her Guard", by A. J. W. Burgess; "Suburbia, 1939", by C. R. W. Nevinson, A.R.A.; and "Retribution", the end of a U-boat, by Arthur Burgess, bear testimony to the less spectacular necessities of these times.

So far as strictly scientific activities are concerned, this exhibition is no more lavish than its predecessors. If the highways and byways of scientific endeavour have any artistic stimuli, it must be admitted that the results do not pass the strait gate of Burlington House. Of the seventeen hundred works now shown, only about ninety can be said to be even incidentally of scientific interest, and that is taking both science and the subjects of the pictures at a very wide estimate.

As usual, the botanists and the geologists have nearly all the spoils, largely because flowers are amongst the most convenient themes for both indoor and outdoor painting, and because, on the other hand, landscape painters of even the most modern school can scarcely avoid some hint of the geological background.

Agriculture, as in last year's exhibition, has one of the best pictures of the year, by that habitual author of 'best pictures', Dame Laura Knight. It is entitled "January, 1940", and depicts a land-girl at work in wintry surroundings.

Archæology is represented by Charles Oppenheimer's large and pleasing "Roman Wall, Northumberland", and by Mr. W. P. Robins's more topical "The Saxon Ship at Sutton Hoo". There is a score of castles from many parts of this and other countries, and in various stages of disrepair, which may also attract the antiquary, but space does not permit their catalogue here.

For the anthropologist there is a small number of pictures of distinguished artistry and origin. Negroes, Chinese and Gypsies are the favourite subjects: and of these Laura Knight's "The Gypsy" (purchased under the Chantrey Bequest); Sir John Lavery's "Gypsies in Ireland", a work painted some years ago; and the continuation of Mr. Gerald Kelly's charming Burmese studies must be mentioned.

For the botanist, or perhaps more accurately the flower-fancier, the Academy must be a delight. Art does more than memory, for it gives us roses all the year round. Here, there are roses in plenty, and lilies, pinks, cornflowers, cinerarias and tulips, "Spring Flowers", "June Flowers", "Summer Flowers", from anemones to zinnias. Trees there are, too, trees casting their cool and leafy shade, trees burdened with snow, and trees brilliant with blossom. Attractive and somewhat unexpected examples of the latter group are Mr. George Belcher's "Tugley Farm", with its contrast of summer sun and shade, and the luxuriant foliage of Mr. A. J. Munnings' "Drifting", a large and colourful canvas with a canoe on the limpid waters of a tree-shaded stream.

Geologists with imagination have an even richer field this year in which to exercise their fancy. Scottish scenery vies with the English moorland for pride of place, with coastal attractions of the south and the staccato splendour of the Alps following on; a variety which is happily knit by the versatility of Oliver Hall, R.A., who shows typical highland features in his "Bridge in Inverness-shire", the characters of its English counterpart in "Rothbury Moors, Northumberland", and supplies the continental contrast of a recently dissected plateau in "Ronda, Spain". A somewhat sharper contrast in topography is seen in the gently rounded features of the old landscape of "A Fifeshire Farm", by R. W. Stewart, and the jagged boldness of the "Dents du Midi" of the late Melton Fisher. "Winter in a Cotswold Village" (A. G. James) and "Winter in Perthshire" (McIntosh Patrick) are gentler variations of the same theme, to be compared with the sterner work of snow and ice visible in "Zermatt" by Mrs. Elwell. For a complete contrast there is the attractive panorama by Charles Gere, R.A., entitled "The Tidal Severn", with its well-displayed meanders. Typical cliff and coastal scenery, which is perhaps even more attractive to the field geologist, is supplied by Gerald Kelly in his "Golfo Tigulio, II"; in "Swanage", by R. R. Gill; and especially in "The Mewstone: Entrance to Dartmouth from Seaward", by Charles Pears.

Applied geology is represented only by "The Derelict", a tempera painting by Mr. Harry Allen, which shows an old quarry and its abandoned crusher.

Mineralogy is almost entirely unrepresented. Hitherto it has been safe to rely upon the jewelled richness of Gerald Brockhurst's portraits, but Mr Brockhurst is one of many academicians who have not exhibited this year. The meteorologists, too, must take what they can from a very few landscapes, of which Sir A. Brown's "A Passing Shower", with its thundery sky, and Bertram Priestman's "Storm Clouds, North Wales" call for special mention.

The important and attractive field of industry and engineering is unexpectedly neglected, although Alan Blyth's two topical pictures "Building an R.A.F. Aerodrome" and "Evening at an R.A.F. Aerodrome" do something to alleviate the deficiency.

The number of pictures of zoological interest is also smaller this year. Mr. Munnings' studies of racehorses as usual command attention, and Dame Laura Knight contributes a delightful scene of a quieter kind in her "Suffolk Mare and Foal". Miss Jessie Hodge also has a pleasant study of a swan with its chicks in "All Aboard!". Phillip Connard's "Pelicans", which has been bought for the Academy under the Chantrey Bequest, is of interest, as is Mrs. Daisy Smith's "Amherst's Pheasant". The farmyard aspect is supplied by "Gloucester Spots at Abnash", by J. A. Colquhoun Morrison.

"The Aviary", by James Fitton, is suggestive of a zoo; while "Painting the Air Balloon", a tempera by Ernest Dinkel, reveals a glimpse of the museum workshop.

There are several items of architectural interest for scientists: "Scaffolding at Winchester College, 1938"; "Canterbury Quad, Christchurch, Oxford"; "Hertford College Bridge, Oxford"; "The University of London, Interior of Great Hall"; "Goldsmiths' Library, University of London"; and an interesting model of the new University buildings in Bloomsbury by Charles Holden. There are also drawings and plans of the Courtauld Science and Art Block of Felsted School, and of the Garden Court Wing of the British Medical Association.

Portraits or statuary of scientific and university men are not numerous, but the few are worthy of attention. Pre-eminent among them is the splendid life-size painting of the late Lord Crawford by James Gunn, one of the best pictures in the exhibition. Augustus John celebrates his return with a fine portrait of the Hon. Vincent Massey; and Mr. R. G. Eves, R.A., has deposited as his diploma work his portrait of Sir Joseph Barcroft. The Rev. E. Schomberg, Master of Charterhouse (Ronald Gray), the late Dr. H. R. Rathbone (L. Campbell Taylor), and Sir Herbert Baker (A. K. Lawrence, R.A.) are other notable portraits. Physicians are well represented by Sir Robert Hutchison (James Gunn), the late Prof. Edward Mapother (A. R. Thomson, A.R.A.), and Dr. E. B. Gunson (James B. Manson). There is also a charming miniature of Dr. Cyril Horsford by his daughter.

Museum men will be pleased to see the miniature of Dr. Charles ffoulkes by Dorothy Garratt, and the sanguine by Robert Swan of Mr. F. W. Troup. Miss Helen Campbell has done a chalk study of Sir Dennison Ross.

Amongst the sculpture there must be mentioned the bronze bust of Lord Cadman (Donald Gilbert), the bronze bust of Sir David Milne-Watson (Eric Schilsky), and the model of a bronze memorial to Sir Archibald Denny (L. S. Merrifield). Miss Barbara Tribe has done an excellent bust of that distinguished soldier and master of Peterhouse, Lord Birdwood. Mr. Bertram Pegram exhibits a bust of Sir Daniel Lleufer Thomas, a welcome testimony to services to the University and National Museum of Wales, and Mrs. Bingguely-Lejeune has a bronze relief of that great patron of the sciences, Lord Nuffield.

DISTRIBUTION OF MARINE ORGANISMS

AT the general meeting of the Linnean Society of London on April 25, a discussion regarding the extent to which the distribution of marine organisms can be explained by, and is dependent on, the hydrographical conditions present in the great oceans was opened by Lieut.-Colonel R. B. Seymour Sewell.

After dealing with the main categories of marine organisms—plankton, nekton, and benthos—and defining the various types of plankton, Col. Sewell considered the ancient Tethys Sea and the effect of its subsequent closure on the distribution of corals. The view has often been advanced that species found to be limited to-day to the North Atlantic and northern part of the Indian Ocean are relics from this early Tertiary sea; but recent investigations have so greatly increased the number of these species that this explanation is unlikely. A study of the ancient group of Crinoids provides an alternative explanation, and suggests that, while some species have reached the Atlantic and Arctic Oceans from the centre of origin in the region of the Malay Archipelago through the Tethys Sea, others have been dispersed along lines which correspond closely with the surface and deep-water currents of the present day.

There can be no doubt that the character and direction of flow of marine currents have had a profound influence on the fauna and flora of different regions, and are sufficient to account for the frequency with which species are found to be cosmopolitan in their habitat. Further, the convergence zones set up in regions where the different current systems abut upon each other may provide temperature barriers across which only the most tolerant species are able to pass, and thus give us sharp boundary lines between two types of fauna or flora.

Detailed studies of various groups of animals and plants within the limits of a single ocean have produced an important body of evidence as to the correlation between the distribution of the organisms and the presence of water of a particular origin, as well as the direction and extent of flow of this water. This has been well shown in investigations on both phyto- and zoo-plankton of the North Atlantic, as well as on the diatoms of the Southern Ocean, and evidence is also accumulating that benthonic organisms may be affected in much the same way, as shown by recent work on sea-urchins, barnacles and sponges.

A study of the various zoogeographical regions which have been delimited as the result of work on the surface plankton reveals that these correspond fairly closely with the surface currents, and that the main line of dispersal for such plankton runs from east to west. A systematic study of the weed-haunting Harpacticid Copepods or of the surface-living Calanoids suggests that a very large percentage of the species of these crustaceans must have originated in the region of the Malay Archipelago, and that the farther we get away from this region the smaller is the number of Indo-Pacific species to be found, as might be expected if their dispersal is due to the surface currents. Similar evidence has been provided by the distribution of other groups of animals and of the littoral algæ.

In regard to the deeper levels, a study of the distribution of the meso-planktonic Calanoids again shows a distinct correlation with the general trend of the mid-water and deep currents. In this group the centre of origin appears to have been largely in the North Atlantic, and their distribution can be shown to follow the lines of the deep currents from west to east. Investigations on the Scyphomedusæ of the Indian Ocean suggest that these organisms have followed the same route, but we find that their distribution in the Indian Ocean is limited by the recently discovered azoic area in the Arabian basin and the Gulf of Oman. In this area, between depths of about 500 and 1,250 metres, there is a marked deficiency of oxygen, and the effect of this is well shown in the vertical distribution of two species of Calanoid copepods within and without the affected area.

With regard to the nekton and the benthos, the movements of the water masses must play a part in the dispersal of the eggs and larval stages while these are planktonic. The distances to which such forms can be carried by currents, however, will depend partly on the rapidity of the current and partly on the length of the larval period, but at the same time a study of the bottom topography reveals the presence of a number of 'stepping stones' by means of which a species could pass from one ocean to another in a series of successive generations.

In conclusion, Colonel Sewell pointed out that the cosmopolitan habitat of many species might well be accounted for by the influence of ocean currents on distribution. Further, a uniformity of the fauna and flora has not yet been achieved in spite of the long period of time that has elapsed since the oceans assumed their present positions and connexions in the middle of Tertiary times; nor can this be achieved while new forms continue to make their appearance. The ability of a given species to obtain a cosmopolitan range seems to depend to a great extent upon the ocean in which it made its original appearance.

Dr. Maurice Burton dealt with the distribution of marine sponges, and stressed the importance of sound systematics as a preliminary to zoo-geographical investigation. He agreed with Colonel Sewell as to the important part played by ocean currents in the dispersal of species, and pointed out that the distances reached depend to a great extent upon the duration of the larval life. The metamorphosis of a larval sponge on the surface film, which has been recorded under laboratory conditions, might well have a decided effect upon the dispersal of certain forms in the sea.

Dr. Anna Hastings considered the distribution of antarctic and subantarctic Cellularine Polyzoa. She showed that the distribution of the species is very closely related to hydrographic conditions, only 20 per cent of subantarctic and antarctic species being common to the two regions as limited hydrographically by the Antarctic Convergence. A similar separation is noticeable, and usually even more marked, in the few other groups of animals for which data have been obtained.

On the other hand, the distribution of the genera of antarctic Cellularine Polyzoa does not appear to be specially related to hydrological conditions. Their distribution points to eastern rather than western affinities, that is, with the Australasian, Malayan and Japanese faunas rather than American. This is also found in other groups, but not in the antarctic Echinoderms (D. D. John, 1937). These tendencies are difficult to relate to present hydrological conditions, and are more probably due to interrelations of the geological history of the region and the phylogeny of the groups.

Mr. J. R. Norman pointed out that fishes, being for the most part active swimmers, are not dependent upon the ocean currents for their distribution to nearly the same extent as the invertebrates already mentioned, although these may be an important factor in transporting pelagic eggs and larval stages, as in the case of the European eel. In the case of coastal fishes, including the littoral forms as well as those occurring at no great distance from the shores in water down to about 500 metres in depth, the most important hydrological factor influencing their distribution is the temperature of the sea. By taking the mean annual surface isotherms of 6° C., 12° C., and 20° C. respectively, it has proved possible to delimit a series of zones of distribution in the sea, each with its more or less peculiar types of fishes. For example, the distribution throughout the world of the genus Sardina has been shown to lie roughly within the area bounded by the isotherms of 12° and 20°. The isotherm of 12° runs very roughly to the mouth of the English Channel, and it is just here that such warm-water forms as the pilchard, anchovy and red mullet are replaced by the herring, cod and plaice, and other cold-water types. This is also near the southern limit of the salmon and trout as marine fishes.

The islands of Tristan da Cunha and St. Paul, lying in the southern Atlantic and the southern Indian Ocean respectively, are about 4,000 miles apart but situated more or less on the same mean annual surface isotherm : there are certain species of fish common to these islands but found nowhere else. The fact that the Antarctic Drift runs direct from one island to another may have been a factor in assisting the spread of these fishes. There are about 90–100 species of fishes commonly found in the Patagonian - Falkland Islands region, but only three of these are found at the island of South Georgia, a bare 800 miles away but separated by the Antarctic Convergence, corresponding closely to the isotherm of 6° C.

Of the oceanic fishes, the pelagic forms, although they appear to have on the whole a wider distribution than most coastal fishes, still seem to be limited mainly by temperature. In the case of the abyssal forms, the contour of the sea floor may play an important part in limiting their range, and it may be noted that the submarine ridge running from Scotland to Iceland and Greenland, less than 1,000 metres in depth, is the northern limit of the Macruridæ, the most characteristic family of bottom-living oceanic fishes. Our knowledge of the distribution of the bathypelagic fishes is still very incomplete, but it may be said that a number of them have a cosmopolitan range and that recent investigations have tended to add greatly to this number. Some of them are capable of extensive vertical migrations, and it may be that they are able to negotiate barriers which would be effective in limiting the spread of coastal fishes.

Dr. Stanley Kemp emphasized the importance to the general question of marine distribution of the comparative stability of species in the sea, and instanced the occurrence of identical species of fish and crustacea on both sides of the Isthmus of Panama in support of the view that species can remain identical over a long period of time. He thought that this would account for some of the instances of bipolarity, and mentioned a Euphausian common in the north and south but absent over a large stretch of the middle Atlantic. If species have remained unaltered for long periods of time, any arguments which base distribution upon existing ocean currents must be fallacious.

As an example of the adaptation of a planktonic fauna to hydrographical conditions Dr. Kemp mentioned the work of Mackintosh, who had shown that plankton at the time it approaches the Antarctic Convergence sinks to a deeper level and in this way is carried back to its proper habitat in the Antarctic. The deep-water prawns of the genus Acanthephyra, which are abundant in tropical and temperate parts of the oceans, have recently been investigated in detail, and have been found to have become differentiated in the various oceans. The species are separated by quite trivial characters (the number of spines on the telson), which are, however, astonishingly constant. One species in the Atlantic shows a widely discontinuous distribution.

Dr. G. P. Bidder wondered whether the length of the larval life was really so important a factor in the dispersal of sponges, and suggested that in the case of calcareous sponges these might be carried to new localities on the bottoms of ships. He pointed out that the largest and finest specimens found at Naples and Plymouth were collected from vessels anchored in harbour for a month or so.

Prof. W. Garstang suggested that an interesting approach to the problem as far as pelagic animals are concerned would be to tabulate the differences in distribution of those forms with large and small larval stages respectively.

OBITUARIES

Prof. Jules Schokalsky

THE distinguished Russian geographer Prof. Jules Schokalsky died in Leningrad on March 26 at the age of eighty-four. He was widely known throughout Europe and America, where he made many friends at international scientific gatherings. As a boy he lived much in the country and acquired a love of Nature by his comradeship with a son of the poet Pushkin, and this æsthetic sentiment opened the way to serious scientific study. He led a life of ceaseless activity from the time he entered the Naval School at St. Petersburg in 1874 until his death, and for forty-five years I have had the privilege of enjoying his helpful friendship. Even the shock of the Russian revolution of 1917 did not check the continuity of his work; to him science was superior to politics. He continued under the Soviet system in Leningrad to give full expression to the enthusiasm for oceanography and cartography which had animated him during half a century under the Empire.

Schokalsky studied at the Naval School in St. Petersburg, and in 1877 he went to sea as a midshipman in the Imperial Navy. After two years he turned to shore work connected with naval research and education, spending three years at the National Physical Observatory under the great meteorologist, Dr. H. Wild. After this he joined the teaching staff at the Naval Academy and was professor and then emeritus professor of physical geography, meteorology and oceanography from 1910 until 1930. For a time he was librarian of the Central Library of the Russian Admiralty, and he ended his academic career and his life as professor in the University of Leningrad. He found time for innumerable honorary appointments, culminating in the presidency of the Imperial Russian Geographical Society, which he held for many years, and on his retirement was appointed honorary president of the same Society under the U.S.S.R.

He was a tireless writer with nearly five hundred entries of publications under his name, many of them, of course, being official reports, summaries and criticisms. His most important book was the "Treatise on Oceanography", in Russian, published in 1917. This is a work of originality and distinction, showing much ingenuity in the design of illustrative diagrams. He produced or edited with valuable introductions many atlases of the physical features of Russia. He paid special attention to hypometrical work and completed a map of the altitudes of European Russia in six sheets on the scale of 1 : 2,500,000.

Schokalsky planned and carried out an important series of researches on the temperature regime of Lake Ladoga during the years 1897–1902. The supreme contribution which he made to oceanography was the organization of physical investigations in the Black Sea. This was carried out under his personal leadership during 1924–27 in conditions of much difficulty and even privation. The result was to throw new light on the remarkable physical and chemical changes proceeding in the lifeless deep water of this anomalous land-locked basin. A special feature of the work was the collection for the first time of very long cores of deep-sea deposits; the length of these ranged up to one and a half metres.

Prof. Schokalsky had much charm of manner and great kindness of heart combined with dignity and a fine sense of honour. He made himself welcome wherever he went despite the deafness which latterly grew upon him. His later years were cheered by the companionship of a devoted daughter, herself distinguished in the modern science of soil analysis.

Hugh Robert Mill.

Sir James Mackenna, C.I.E.

Sir James Mackenna, who died on April 3, aged sixty-seven, belonged to the small band of members of the Indian Civil Service who, though not scientific workers themselves, employed their long service in India in encouraging the application of science to the solution of the agricultural problems of the country. I first met him in 1904, when he had been some ten years in Burma and was already recognized as one of the most successful directors of agriculture of his time. Even then he showed those qualities which distinguished him throughout his career—a thorough grasp of the problems of rural development, a strong belief that agricultural research was likely to lead to a great improvement in Indian crops and stock, and a faculty for getting things done. From this time on, his work as a member of the Indian Civil Service was chiefly concerned with agricultural development in Burma, until he was appointed agricultural adviser to the Government of India in 1916.

Mackenna's work in the last-named position was of outstanding importance. On his recommendation, two committees were appointed to consider, respectively, cotton and sugar production in India in all their aspects, and the results on the development of these industries have been very great. The former committee, among other things, recommended the establishment of the first self-supporting research organization for a purely Indian industry, and the existence of the Indian Central Cotton Committee, a permanent body with ample funds which controls research on cotton problems throughout India, has been very much of a landmark in the later agricultural history in India. Similar bodies have more recently been formed in connexion with other industries, but the idea came from the Mackenna Committee, and was probably the idea of Mackenna himself.

In 1920 he went back to Burma, and for the next five years he was the life and soul of many development projects which date from that period. After retirement to England in 1925, he was almost at once appointed a member of the Royal Commission on Agriculture in India, and toured the country again between 1926 and 1928. The chief result of that Commission has been the establishment of the Imperial Council of Agricultural Research and it is impossible not to see Mackenna's hand in a good deal of the organization of that Council, which has become the centre of scientific activity in connexion with Indian agriculture.

After his final retirement from India, Mackenna continued his interest in scientific work, especially as concerns Indian agriculture. He remained active to the end and was still the same inspiring personality as he had been in his prime. His principal claim to scientific recognition is that he never ceased to use the strong influence which he could exert, for the encouragement of research, while he had the faculty of inspiring those who were entrusted with the carrying out of the work which he had in mind.

H. H. Mann.

Sir Gilbert Barling, Bart.

Sir Gilbert Barling, Bart., died suddenly of heart failure at his home in Edgbaston on April 27, within three days of his eighty-fifth birthday. Sir Gilbert was the second vice-chancellor (afterwards pro-chancellor) of the University of Birmingham which he served for twenty years, having succeeded Charles Gabriel Beale in that office in 1913. From 1913 until 1933 he gave invaluable service to the University, which derived great benefit from his forceful personality and his unremitting personal devotion to its interests. Himself actively interested in outdoor sports, he did much to encourage the athletic side of university education. At the annual meeting of the Birmingham United Hospital, only a week before his death, Sir Gilbert was presented with an address of congratulation on completing sixty years of strenuous service to the hospitals of Birmingham.

We regret to announce the following deaths:

Mr. Owen Cattell, director of the annual exhibition of the American Association, assistant to the editor of *Science*, on March 26, aged forty-two.

Prof. Alexandre Desgrez, emeritus professor of medical chemistry in the University of Paris, aged seventy-six.

Captain E. E. M. Joyce, the well-known Antarctic explorer, on April 2, aged sixty-five.

Mr. G. W. Partridge, a pioneer of electricity supply, on May 3.

NEWS AND VIEWS

André-Jean Marie Brochant de Villiers (1772–1840)

ON May 16 occurs the centenary of the death of the French geologist and mineralogist Brochant de Villiers, through whose initiative the construction of a complete geological chart of France was undertaken. Born at the Château de Villiers, near Mantes, on August 6, 1772, he was educated under the Oratoriens and acquired a taste for natural history. When nineteen, he went to Freiburg, in Germany, to study under Werner, by whom he was much influenced. In 1793, when the Revolutionary movement in France was at its height, he entered the École des Ponts et Chaussées and afterwards the École des Mines. In 1804, when the École des Mines had been removed to Pezay, in Savoy, Brochant de Villiers was made professor of geology and mineralogy, and he held this post for some years after the return of the school to Paris in 1815. He also became an inspector-general of mines and a member of the Paris Academy of Sciences.

So early as 1811, Brochant de Villiers had submitted a plan for a chart of France, but it was not until 1822, when a copy of Greenough's geological map of England was received in Paris, that any definite steps were taken to further his plan. That year, however, he was entrusted with the construction of geological charts for the whole of France, and with his two assistants, Elie de Beaumont and Dufrenoy, he visited England to become acquainted with British methods of geological surveying. With the help of the engineers of the Corps of Mines, steady progress was made, and by 1835, fifty-nine charts of various districts had been prepared, but Brochant did not live to see the first complete map, which was published in 1842. This map was on a scale of 1 in 500,000, but the geological chart of France undertaken later, and completed only a short time since, is on a scale of 1 in 80,000.

Leopoldo Maggi (1840–1906)

LEOPOLDO MAGGI, an eminent Italian protozoologist and craniologist, was born at Varese, on May 15, 1840. He was educated at Pavia, where he was assistant first to Paolo Panceri and then to Balsamo Crivelli, and in 1864 was appointed lecturer in mineralogy and geology. In 1874 he was appointed professor of zoology and comparative anatomy and physiology at Pavia, and afterwards, when zoology became a separate subject, he occupied the chair of comparatve anatomy and physiology from 1875 until his death. He carried out studies in palæontology as well as various zoological and anatomical researches, but his principal work was concerned with protistology and craniology. He was the first Italian to direct attention to Protozoa, to the knowledge of which he made important contributions. His chief publications were as follows: "Nuovi orizzonti della protistologia medica" (1884), "A proposito dei protisti colerigeni" (1885), "I piccoli benefattori dell'umanita" (1886), "Intorno alla determinazione della specie batteriche secondo Pflügge" and "I microbi vantaggiosi all'uomo" (1888). He died on March 7, 1905.

International Spirit in Science

THE award to Sir Harold Carpenter of the Honda Prize was announced in NATURE of March 30. It is of interest to know that this is the second occasion only when the prize has been awarded. The first award was to Prof. K. Honda himself, in whose honour the Japanese Institute of Metals established the prize a short time ago. Prof. Honda's work on the magnetic and other properties of metals is well known to scientific men in many countries outside Japan. It is a striking tribute to the international feeling among men of science that the Japanese Institute of Metals should have chosen, at the present time, a British scientific man as the recipient of what may be regarded as the first 'open' award of its highest honour. During the Napoleonic Wars a century ago, it was possible for scientific men, even those in belligerent countries, to maintain fairly free intercourse and to obtain safe conducts for visits. To-day, the difficulties of the international situation have made such relations most difficult, and the recent recognition by the Japanese of Sir Harold Carpenter's achievements is thus doubly precious.

The Pharmaceutical Society: Honorary Members

IT will be gratifying to medical circles in India to learn that Colonel Ram Nath Chopra, head of the Faculty of Pharmacology in the School of Tropical Medicine, Calcutta, has been elected an honorary member of the Pharmaceutical Society of Great Britain. This distinction is conferred upon a very limited number of scientific workers, the list of honorary members being not more than twenty-five at the present time. Colonel Chopra has been, and still is, an earnest worker in the cause of reform of the drug trade in India; it was upon the recommendations of the Drugs Enquiry Committee, of which he was chairman, that the Indian Drug Bill, the provisions of which measure were commented upon in a recent issue of NATURE (May 4, p. 716), were based. At the May meeting of the Council of the Pharmaceutical Society at which the election took place, two other names were also added to the list of honorary members: Sir Ernley Blackwell, who was chairman of the Society's Statutory Committee during 1934–1939, and Sir William Willcox, the Visitor for the Privy Council to the Society's Examinations.

Nuclear Fission of Separated Uranium Isotopes

SOME recent accounts in the daily Press referring to the separation of uranium (235) would suggest developments arising from a letter in the *Physical*

Review (57, 546), by Dr. A. O. Nier. Nier there describes fission experiments conducted with small quantities of ^{235}U and ^{238}U separated by deposition in a mass-spectrograph. The masses of ^{238}U samples were of the order of 10^{-7} gm. and those of the ^{235}U samples about 10^{-9} gm. The samples were bombarded with slow neutrons obtained originally from a cyclotron. Fission products were observed in an ionization chamber when the ^{235}U isotope was used, but not with the more abundant ^{238}U. The ^{234}U isotope was not separated from ^{235}U, but its abundance is very small. It seems almost certain that ^{235}U is responsible for the slow neutron fission, as predicted theoretically by Bohr and Wheeler.

Shining in Human Eyes

From time to time, reports have appeared of the occurrence in human eyes of the phenomenon of "night-shining", which as was indicated in a recent paragraph (Nature, March 30, p. 506) has been observed in many animals by Ernest P. Walker, assistant director of the National Park of the Smithsonian Institution. It was there stated that Mr. Walker had no definite proof of such cases, although he had encountered reports of them. That statement has led Denis G. A. Dyson, King Edward VI School, Stratford-on-Avon, to write saying that for many years he has known of an "undoubted case" of shining eyes in a shop assistant in Birmingham. Although, not being aware of the rarity of such an occurrence he made no particular observations, his impression is that the glow was of a "dark red colour". In view of the apparent lack of information about such a condition in human beings, it would be of interest if some scientific worker could follow up Mr. Dyson's clue.

War-time Ventilation Problems

The question of ventilation is demanding special attention as the warm weather approaches. Mr. A. Peel's article on "War-Time Ventilation", published in the *Electrical Times* of April 18, is therefore a timely one. Special attention has to be paid to factories, mills, offices, etc., where a large number of people occupy one enclosure. It is an annual problem the solution of which in peace time is not always adopted as soon as it should be. Now certain factors due entirely to the War have greatly aggravated the working conditions in many factories and sometimes added very definite causes of bad ventilation. So far as 'black-out' is concerned, the Government insists that the obscuration must be complete. Whatever form this takes, the blacking-out process is responsible for a marked deterioration compared with the natural ventilation existing before the black-out. Many firms who were obliged hurriedly to arrange their black-out schemes and did so by painting windows or sealing them up by fitting wooden or metal shutters, or in other semi-permanent ways, have already had to strip this material away from windows. This has been necessary in order to get back to something like normal operating conditions as an alternative to serious labour trouble on account of high sickness rates, due to continuous working in artificial light and with poor ventilation.

The proper solution of some of these war-time ventilation problems may involve only the fitting of a small propeller fan or even the opening of all the windows. In other cases it will be essential to use a complete air-conditioning plant whereby a factory or section of a works may operate for twenty-four hours a day all the year round under constant conditions of temperature and humidity, and with an ample supply of clean fresh air to meet all the requirements of the personnel and of the process carried on. Between these two extremes there will be numerous combinations and modifications of method, and every case has to be studied on its own merits. Complete air-conditioning plant is already in operation in Great Britain in certain sections of the following industries: textiles, printing, biscuit and chocolate manufacture, pharmaceutical chemicals, food manufacture and packing, optical and other fine instrument making, and grinding wheel manufacture. In addition, complete air conditioning is also successfully and economically used for offices and other important rooms. By means of a well-designed plant it is possible to provide in a given space almost any combination of dry bulb temperature and relative humidity. Many different combinations of temperature and humidity are used in practice. Anything which can be done to reduce the variation of heat and moisture load and so cut down the total amount of heat to be dissipated will result in smaller and less costly equipment.

Criminal Anthropology in the U.S.A.

The crime wave of appalling dimensions, accompanied by a vast increase in organized crime, which appeared in the United States of America in the years following on the War of 1914–18, continues to constitute one of the gravest of the social problems of State and Federal administration, notwithstanding the repeal of prohibition, which offered an almost unlimited field for illicit gain. In consequence, attention has been directed once more to the possibility of segregating the potential as well as the actual criminal through a method of detection depending upon an anthropometric examination which would weed out or mark down individuals who in their physical characters showed traits characteristic of a criminal type. When crudely stated, this suggests a reversion to the ideas in criminology held by C. Lombroso in the later years of the last century, which anthropologists believed had been laid to rest when it was shown to general satisfaction that no distinctive criminal type could be said to exist. Nevertheless, a vast survey of criminal anthropology in the United States has been instituted under the ægis of the Division for the Examination of Prisons of the Massachusetts Department of Mental Diseases. It has been carried out by Prof. Earnest A. Hooton of Harvard University, with the assistance of a body of field-workers and statisticians.

The dimensions of the investigation may be gauged from the fact that the case material for native white prisoners consists of 4,212 individuals; and foreign, foreign born, negro and negroid criminals were treated on the same scale. Dr. Aleš Hrdlička has been moved by the discussion to revive and review material which he collected more than forty years ago, when the question was previously under discussion (*J. Criminal Psychopathology*, 1, 2; 1939). In 1897–99, the New York Juvenile Asylum contained 1,000 inmates of both sexes, 5–16 years of age, of whom 77 were criminal or vicious, and 61 were the offspring of criminal, insane, intemperate or dissolute parents. Anthropometric measurement of each child in the institution showed that the transgressors could not be separated physically from the remainder, or probably from similar classes outside. Apart from their conduct they could not have been recognized as criminal. Of the children of the intemperate and other undesirables, however, it was found that almost 60 per cent were "inferior in their principal measurements to the general averages of the corresponding class of the asylum children", or subnormal. Dr. Hrdlička's conclusion, therefore, is that it is "hopeless to expect that anthropometry and physical examination can ever aid in this detection".

Malting Barley

THE agricultural data derived from five conferences on malting barley held at Rothamsted Experimental Station in the years 1934–38 have been described and discussed by H. V. Garner and J. W. Weil (*Empire J. Exp. Agric.*, 8, 65). More than a thousand samples of English malting barley were sent in by growers from the more important barley-growing districts, grading being carried out by the Valuation Committee of the Institute of Brewing. Six malting grades were distinguished, three for pale-ale and three for mild-ale barleys, the largest number always falling into the latter groups. Spratt Archer and Plumage Archer were by the far the most popular varieties, and their stiffer straws had encouraged generous manuring. Autumn-sown crops usually proved superior in quality but inferior in yield to the spring-sown barleys of the same district and year, and early sowing was generally found to improve the quality in the latter case.

The effect of the crop preceding the barley was also examined. Sugar beet predominated in Norfolk and Suffolk, and in other districts, including Yorkshire, Lincolnshire and the West, folding roots were frequent, whereas elsewhere a cereal crop was more usually taken. Yield was greater after sugar beet or roots than after corn, in spite of the heavier manuring usually given to the straw crop. Lodged crops yielded more than those which were standing, but the quality of the grain was slightly depressed. Analysis was also made of the inter-relationship between soil, season and quality.

Hygiene of Swimming Baths

IN his inaugural thesis (*Thèse de Paris* 1940, No. 17), Dr. Marcel Mazillier remarks that it has been known from remote antiquity that certain diseases may be spread by swimming baths, as is shown by the fact that admission to them was forbidden to lepers and others suffering from contagious diseases. The micro-organisms found in the water of bathing places are numerous and of various kinds, the water becoming rapidly contaminated by bacteria derived from the mouth, nose, fæces and urine of the bathers. The diseases contracted in swimming baths chiefly affect the throat, ears and eyes. Cases of spirochætal jaundice, in which the disease may be localized in the meninges, may occur as well as skin diseases, especially that known as 'athletes' foot'. It is therefore important that in constructing a swimming bath care should be taken so far as possible to eliminate causes of contamination, whether derived from the bather himself, who should give himself a douch before entering the bath, the water used for washing out the bath, or other sources. Provision must also be made for the proper heating, ventilating and lighting of the establishment. The drinking water, which must possess all the requisite qualities, may be purified by ultra-violet rays, though this is rather a difficult and expensive process, or by the addition of bactericidal chemical products such as chlorine and its derivatives, colloidal metals and ozone.

Tung Oil

THE supply of tung oil has been so profoundly affected by the war in China that considerable interest is attached to a report by Dr. M. Ashby upon his tour of the area in the United States in which the tung tree is now being cultivated (*Bull. Imperial Inst.*, 38, No. 1; 1940). It is estimated that some 175,000 acres in the States bordering on the Gulf of Mexico now carry plantations of this tree, but many earlier plantations were on land that has since proved unsuitable, the great difficulty proving to be frost damage. The species cultivated is almost exclusively *Aleurites fordii* Hemsl.

Details are given of cultivation, harvesting and mill treatment of the crop, etc., and it is clear that a very high-grade quality of oil can thus be obtained, but until 1938 the yield had been uncertain owing to frost damage. Although three million pounds of tung oil were produced in the States in 1938 (against an import of 108 millions in that year), until now the paint and varnish industry practically bases itself upon the Chinese supply, though the war has made this a very uncertain source.

Cinchona Production in the Netherland Indies

AN article by Dr. M. Kerbosch in the *Bulletin of the Colonial Institute of Amsterdam* (3, No. 1, December 1939) gives some notes on cinchona culture and the world consumption of quinine. Existing plantations in the Netherlands Indies could produce considerably more than the present world consumption. The Netherlands Indies Government has at its disposal sufficient guarantees to prevent the agreement between the manufacturers and producers being used in a way which would hamper malaria control. Cinchona growers would welcome the opportunity to increase their output, and the agreement, which has united practically all producers and manufacturers, makes it possible to put regularly at the disposal of malarial areas large quantities of quinine for longer periods. Obstacles to the use of this superabundance of the Java cinchona estates are largely financial and technical. Disbursements for defence in all countries cripple other projects, including health or hygienic measures. In addition, malaria control with quinine requires an efficient administrative machine for the distribution of the drug under medical supervision. For mass treatment of malaria, quinine is unlikely to be replaced by other cinchona alkaloids or synthetic drugs.

United States National Museum

THE report of the United States National Museum for 1939 is a stimulating document, particularly in the evidence it contains of widespread activities in exploration and field work. No fewer than fifteen expeditions or trips were made, mostly to chosen localities in the United States, but also to regions ranging from the South Pacific Ocean to Alaska and West Greenland, for the collection of data or specimens bearing upon archæology, anthropology, stratigraphic palæontology, and animal and plant distribution. Specially noteworthy seem to have been the results of Dr. Hrdlička's tenth visit to Alaska and the Aleutian Islands, where many skeletons and artefacts of a pre-Aleut stock were collected. The educational activities of the Museum, apart from the usual special exhibits, fourteen of which ran almost continuously throughout the year, include an admirable scheme for the allocation of duplicates to schools and other institutions, which benefited to the extent of 3,293 specimens. Exchanges involved the dispersal of 13,362 specimens, and it is gratifying to note that the British Museum (Natural History) was a very active partner in this useful form of scientific co-operation. The catalogues of the various departments now record the collections as containing more than 16 million specimens. The popularity of the exhibition galleries is indicated by the total of 2,233,345 individuals who visited the various Museum buildings, and a glance at the monthly lists shows that the holiday periods of April and August afford welcome opportunities to visitors. The cost of running the Museum during the year was 771,880 dollars.

Rabies Treatment in Southern India

THE annual report of the director, Lieut.-Colonel Iyengar, for 1938 of the Pasteur Institute of Southern India, Coonoor, surveys the anti-rabic treatment given at the Institute and the subsidiary treatment centres during the year. A total of 12,396 persons were treated at the Institute and centres during the year, with twenty-one deaths, a mortality rate of 0·17 per cent. Animals to the number of 561 were also treated. Paris fixed virus, now in its 1,011th passage, was used in the preparation of the vaccine, which consisted of a 5 per cent carbolized sheep-brain suspension prepared by Semple's method. Under research work, experiments were carried out on the cultivation of the rabies virus. Attempts to culture the rabies virus on the chorio-allantoic membrane of the developing hen's egg, so useful for propagation of some viruses, were unsuccessful. In media containing chick embryo brain, propagation of the virus was apparently attained, though the method does not promise to be of much practical importance.

Medical Research in Egypt

THE fifth annual report of the Research Institute and the Endemic Diseases Hospitals, Cairo, by the director, Dr. M. Khalil Bey, contains a summary of the reports of the scientific sections and the clinical reports, including investigations on Egyptian splenomegaly, anæmias and various parasitic affections. A report is also included of the work of the Khanka Malaria Research Station. This gives the results of a mosquito survey of the area, with the species of mosquitoes found, and a description of some of the preventive measures undertaken. These include drainage, filling up of water holes and clearance of water-weeds in places. Breeding places of mosquitoes are treated with Paris green when there are Anophelines only, or with mazout oil if Culex larvæ are also present. In future, the Institute will be named the "Fouad the First Institute and Hospital for Tropical Diseases".

Bermuda Seismograph Station

IT is reported in *Earthquake Notes* (11, No. 4; April 1940) that through the co-operative effort of the Bermuda authorities, the Woods Hole Oceanographic Institute, the United States Coast and Geodetic Survey and Dr. George P. Woollard of Princeton University, the second component of the Milne-Shaw seismograph at Bermuda has been installed, the first records being obtained on December 10, 1939. The significance of this station is not only that earthquakes in eastern North America and the West Indies will be located more accurately, but also satisfactory studies of wave transmission over all mid-Atlantic paths have become possible. The position of this St. Georges, Bermuda, meteorological and seismological station is latitude 32° 22′ 47″ N., longitude 64° 40′ 57″ W., elevation 136 ft.; Mr. C. P. Bartram is in charge.

British Empire Naturalists' Association

THE British Empire Naturalists' Association announces the retirement of its honorary general secretary, Mrs. G. B. Thomason, which took place at the end of April after thirty-five years work. She is a niece of E. K. Robinson, who founded the B.E.N.A., and has been responsible for most of the routine business work of the Association. It is also announced that plans have been made to hold the usual B.E.N.A. summer gathering in the first fortnight of June, and the Ludlow district has been selected: local arrangements will be put in the hands of the Shropshire Branch, and, despite the War, the local interests of fauna, flora and scenery are hoped to attract a good attendance.

Summer School in Social Biology

THE Educational Advisory Board of the British Social Hygiene Council is arranging a summer school for teachers to be held at Westminster College, Cambridge, during August 1–8. The school is to focus on "Social Biology in the School: War-time Problems". The services of distinguished speakers are being secured. A series of symposia is also being arranged, at which teachers will be invited to express their views. Further particulars can be obtained from the Education Officer, Educational Advisory Board, Tavistock House South, Tavistock Square, London, W.C.1.

International Congress of the History of Sciences

THE fifth International Congress of the History of Sciences will be held at Lausanne next September if the political and social conditions of Europe permit. M. Aldo Mielli, the perpetual secretary of the International Academy of the History of Sciences, having now settled at Santa Fé in the Argentine Republic, as director of the history of sciences at Santa Fé University, M. J. A. Vollgraf of Leyden has been appointed assistant secretary for Europe and the Mediterranean countries. The review *Archeion*, the official organ of the Academy, will henceforth be published at Santa Fé instead of at Rome as hitherto.

National Research Council of Canada: Awards

SIXTY-SIX Canadian university students will take training in research in Canadian institutions under National Research Council Scholarships during 1940–41. While the majority of these students will be engaged in chemical and physical investigations, such biological studies as genetics, plant pathology, physiology and zoology will each have a quota of students. Two Special Scholarships of 1,000 dollars each will be held in the Division of Chemistry at the National Research Council laboratories, by R. L. Cunningham and R. B. Harvey of McGill University. Four Fellowships of the value of 750 dollars each, and thirty-seven Studentships of the value of 650 dollars each, will be held at Canadian universities directly under the auspices of the National Research Council. With the co-operation of Canadian universities, the National Research Council is also awarding twenty-three bursaries of 250 dollars each. These bursaries are available to students of high attainments who have just graduated and are ready to take their preliminary training in research.

Announcements

ON May 19, 1939, the seventieth anniversary of his birth (see NATURE, **143**, 813, May 13, 1939), a number of Prof. Henry H. Dixon's friends, colleagues and students presented him with an address expressing their regard for him and appreciation of his work. This address, with more than seven hundred signatures, beautifully bound, has now been handed to Prof. Dixon, and he asks us to convey his sincere thanks to all who shared in doing him this honour.

PROF. J. C. DRUMMOND, scientific adviser to the Ministry of Food, will give an informal luncheon talk at the Chemical Club, 2 Whitehall Court, London, S.W.1, on May 20. He will take as his subject "Essentials of Wartime Diet".

FIVE members of the Ling Physical Education Association have received decorations awarded by the Fédération Internationale de Gymnastique Ling in recognition of their services on behalf of physical education: they are Miss M. Stansfeld, principal of the Bedford Physical Training College; Miss M. Fountain, principal of the Chelsea College of Physical Education; Miss P. Spafford, secretary of the Ling Physical Education Association; Mr. F. Punchard, Scottish secretary of physical education, Jordan Hill; and Mr. K. Rofer, author of several books on physical education.

DR. J. W. LLOYD has been appointed acting head of the Department of Horticulture in the College of Agriculture, University of Illinois, to succeed J. C. Blair, who founded the department thirty-nine years ago. Dr. Lloyd, who has worked on the staff for many years, has directed research on fruit and vegetable crops.

DR. DETLEY W. BRONK, director of the Eldridge R. Johnson Foundation for Medical Physics and of the Institute of Neurology, University of Pennsylvania School of Medicine, has been appointed managing editor of the *Journal of Cellular and Comparative Physiology* of the Wistar Institute of Anatomy and Biology in succession to Edmund Newton Harvey, of Princeton University.

THE Pan-American Congress of Tuberculosis will be held at Buenos Aires and Córdoba during October 13–17 under the presidency of Prof. Gumersindo Sayago. Further information can be obtained from the general secretary, Dr. Raúl Denis, Calle Pasteur 346, Buenos Aires.

THE lowest maternal mortality ever recorded in the United States—43·5 per 10,000 live births—has recently been recorded by the United States Bureau of the Census for the year 1938. For the first time on record less than 10,000 (9,953) deaths were assigned to puerperal causes.

ACCORDING to an official report there are at present 1,941 foreign students in German universities representing the following countries: Bulgaria, 532; Norway, 142; Greece, 101; with Yugoslavia, Italy, China, the Baltic States, the Scandinavian countries and the United States showing small numbers.

WITH its February issue the *Journal of Contraception* was renamed *Human Fertility*; it will continue to be issued under the auspices of the Birth Control Federation of America.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 749. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Relation between Breaking and Melting

IN a recent paper[1], M. Born has given a new theory of the melting of crystals which is in good agreement with the experimental facts. The stability conditions of a lattice at a certain temperature and a certain uniform pressure for arbitrary small homogeneous deformations are derived, and it is stated that melting will take place when, on raising the temperature, at least one of these conditions is violated. In another paper by Prof. Born and myself to be published shortly, an attempt is made to calculate the tensile strength of a crystal at zero temperature. Here again, the stability conditions of the lattice, stressed in the direction of one of the axes, against any small homogeneous deformation, are derived, and the crystal is supposed to break if one of these conditions is violated. Thus a close relation between the two phenomena of melting and breaking seems to exist, melting being nothing else than a breaking due to the action of the heat movement of the atoms; or putting it the other way round, breaking is nothing else than melting enforced by the action of the stress. Unfortunately, the theory mentioned above, like other former theories, gives results not in agreement with experiment: the tensile strength as well as the critical deformations calculated from this theory with plausible assumptions are about a hundred times larger than the real values given by experiment.

Now, one of the results of the theory of breaking is that the tensile strength should be of the order of magnitude of the heat of sublimation per unit of volume. But, as a consequence of what is said above about a connexion between breaking and melting, one would expect a connexion between the tensile strength and the heat of melting rather than the heat of sublimation. Indeed, comparing the experimental values, one can see immediately that the tensile strength is of the same order of magnitude as the heat of melting per unit of volume. This observation has led me to consider the connexion between these two quantities more thoroughly, and I have succeeded in deriving an equation from which the tensile strength F of an isotropic body at low temperature can be calculated exactly, if the melting heat Q (per unit of mass), the density (ρ), and the Poisson constant (μ) of the substance are known. This theory and a number of other considerations concerning Born's theory of melting and the thermodynamics of crystals, and other relations between melting and breaking will be published shortly.

The main idea of the theory is that one has to compare two 'states' of a system: (1) the uniformly stressed rod with a volume $V + \delta V$, and a certain potential energy U distributed uniformly over the whole rod; and (2) the rod just before it is broken, the energy U concentrated in the volume δV and melting the matter in it, and the rest of the matter unstressed and with no potential energy. The condition for breaking is that the energies of these two states should be equal. The external conditions must be chosen so as to prevent movement of the broken pieces and to allow of an exact energy balance, including the device for the production of the breaking force. In this way one gets the equation:

$$F = Q\rho\,\frac{1-2\,\mu}{3-5\,\mu}.$$

In the following table the experimental values of the tensile strength, extrapolated to very low temperatures, together with the values of Q, ρ, and μ are tabulated for all elements for which experimental data for the dependence of tensile strength on the temperature were available.

Element	$F \times 10^{-2}$(kgm./cm.^{2})	Q(cal./gm.)	ϱ	μ	$\frac{Q\varrho}{F}\frac{1-2\mu}{3-5\mu}$
Ag	29	25	10·5	0·38	0·85
Al	23	90	2·7	0·345	1·1
Au	27	16	19·3	0·42	0·89
Cu	32	50	8·9	0·35	1·4
Fe	80	66	7·8	0·28	0·75
Ni	55	63	8·8	0·31	1·2
Pb	4	6	11·3	0·445	1·03
Pt	34	27	21·4	0·385	1·6
Sn	12	14	7·3	0·33	1·08
Zn	30	26	7·1	0·33	0·66

The last column gives the values of $\frac{Q\rho}{F}\,\frac{1-2\,\mu}{3-5\,\mu}$, which quantity should equal unity, if our formula is correct. The average value is 1·065 and the mean deviation from that average 0·255, which is not larger than the uncertainty of the experimental values. The mean error of the average is accordingly 0·085, and the deviation of the average from unity is within the experimental error. Thus the theory is in perfect agreement with the experimental facts.

R. FÜRTH.

Department of Applied Mathematics,
University of Edinburgh.

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[1] Born, M., *J. Chem. Phys.*, **7**, 591 (1939).

THE most important and conspicuous property of matter, namely, the strength of solid materials, the fundamental quantity for building, engineering and textile industries, has been hitherto completely unexplained; Prof. Fürth's results should remove physics from this embarrassing situation.

Quite apart from the theory, Fürth's empirical result, that magnitude of tensile strength and heat of melting are of the same order, is new and surprising. His formula expresses this relation quantitatively with the help of Poisson's elastic constant and is in perfect agreement with the experimental data available. The theoretical derivation uses a kind of thermodynamical equilibrium which differs from the usual methods; this is due to the fact that a solid under stress is not a genuine statistical equilibrium. This question needs further investigation though one can scarcely doubt the correctness of the resultant formula. The view due to Smekal that breaking strength belongs to the structure-sensitive (*struktur-empfindlich*) properties of solids must be abandoned, since it can be derived by thermodynamical reasoning without even mentioning atomic structure.

Max Born.

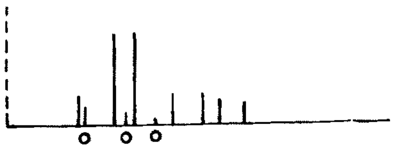
Department of Applied Mathematics,
University of Edinburgh.

An Electron Diffraction Study of the Surfaces of Alkali and Alkaline Earth Metals Exposed to Air

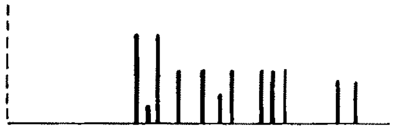
The most corrodible metals are those of the alkali and the alkaline earth groups. The products forming on a freshly cut surface of these metals on exposure to air were studied.

A fresh clean surface of lithium was allowed to stand in air for about five minutes. The diffraction pattern obtained from such a surface clearly showed the formation of lithium oxide (Li_2O) mixed with a small amount of lithium hydroxide.

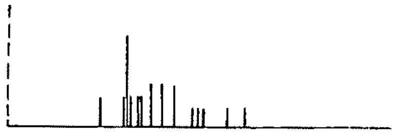
The pattern obtained from the surface of sodium similarly treated showed the formation of sodium bicarbonate; a micro-chemical analysis also verified the presence of the CO_3^{--} radical.



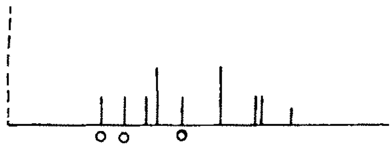
Diffraction pattern from lithium specimen. o, LiOH; other lines, Li_2O.



Pattern from sodium specimen, showing mainly the existence of $NaHCO_3$.



Pattern from potassium specimen, showing mainly the existence of $KHCO_3$.



The pattern from calcium specimen. o, Ca; other lines, CaO.

The formation of potassium bicarbonate on the surface of potassium in similar circumstances also occurs, but in this case the diffraction rings are sharper than those of sodium bicarbonate on sodium; this suggests that the reaction producing potassium bicarbonate is faster than that producing sodium bicarbonate.

Similarly, a moderate quantity of calcium oxide (CaO) was found to be formed on the surface of calcium exposed to air for about five minutes. On comparing this pattern with that obtained in the magnesium experiment under similar conditions[1], it is apparent that the oxide film on calcium is much thicker than that on magnesium.

These results reveal the fact that the carbon dioxide in air can act on potassium or sodium within the limited period of about five minutes, but not on lithium or calcium; while oxygen and the moisture in air act on all metals here investigated.

Full details of these experiments will be published in the *Scientific Papers* of this Institute. The work has been conducted under the direction of Dr. Ichiro Iitaka.

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[1] Iitaka, I., and Yamaguchi, S., Nature, **144**, 1090 (1939); Yamaguchi, S., *Sci. Pap. Inst. Phys. Chem. Research*, **36**, 463 (1939).

Separation of Uranium Isotopes

The separation of the uranium isotopes is of interest because only one of the isotopes, ^{235}U, is believed to undergo fission when bombarded by slow neutrons. The best way to check this theory would be to change the relative particle density of ^{235}U and to see if that has any influence on the number of fissions caused by a certain number of neutrons. If the theory proves correct, one might be able to cause a nuclear chain reaction by concentrating ^{235}U and removing the other isotopes, which only catch neutrons without producing new ones.

To begin with, the most suitable method for concentrating ^{235}U seems to be the thermal-diffusion method of Clusius and Dickel[1] or Brewer and Bramley[2], this method being a universal one, applicable to all elements. Of course, other methods, specifically suitable for uranium, may be found later on. The thermal diffusion method can be used both for liquids and for gases, but it works extremely slowly when applied to liquids. It is much better to use gases. The only volatile compound of uranium is uranium fluoride (UF_6). The dimensions of a thermal-diffusion tube system, using this compound, can be calculated from the formulæ of Furry, Jones and Onsager[3]. We shall use the same notation as these authors.

The molecular weight of uranium fluoride being 352, the factor α is about $1 \cdot 5 \times 10^{-3}$. The temperature of the colder outer tube must be about $T_1 = 333°$ K. $= 60°$ C., if the apparatus is run at ordinary pressure, as uranium fluoride is a solid below 59° C. at a pressure of 760 mm. mercury. The temperature T_2 of the hot tube can be about $2T_1 = 666°$ K. $= 393°$ C., as experiments have been made with uranium fluoride at 440° C. without decomposition of the gas. Too high a temperature would increase the difficulties of getting materials resistant to uranium fluoride and the loss of energy caused by radiation of the hot tube. For the length of the tubes we take $2l = 10$ m.; for the outer diameter of the inner tube 4 cm. and for the pressure 1 atmosphere. The natural abundance of ^{235}U is 1/139, and if we demand a tenfold increase of the relative particle density of ^{235}U in the equilibrium state of discontinuous operation, we must put $A_d = 1{\cdot}49 \times 10^{-3}$ cm.$^{-1}$. For uranium fluoride no value has been measured for D, the coefficient of thermal diffusion, and η, the viscosity, but we may assume $D \sim 0{\cdot}05$ cm.^{2}/sec. and $1{\cdot}4\ \ \eta/\rho = D$ (ρ = density). This assumption gives us for $2w$, the distance between the tubes, $2w = 1{\cdot}34$ mm.

If the top reservoir contains 5 gm. uranium fluoride, the relaxation time would be 80 days. After this time, the concentration of ^{235}U would have increased to 6·7 times of its original value, or to about 4·8 per cent. If we remove the fluoride after this time from the top of the apparatus, we should get about 62·5 mgm./day of uranium fluoride, or 42·5 mgm./day of uranium, 4·8 per cent of the uranium removed being ^{235}U. In continuous operation we should get only 41·7 mgm./day of uranium fluoride or 28·3 mgm./day of uranium, if 4·8 per cent of the uranium removed be ^{235}U.

Thus a considerable quantity of uranium fluoride with the abundance of ^{235}U several times greater than its natural value can be produced by an apparatus which would not be too difficult to construct and to run. I began to construct such an apparatus together with B. Grabe, in August 1939, but the work had to be discontinued because of the political situation.

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[1] *Naturwiss.*, **26**, 546 (1938).

[2] *Phys. Rev.*, **55**, 590A (1939).

[3] *Phys Rev.*, **55**, 1083 (1939).

Radio Wave Reflections in the Troposphere

IN recent publications, Friend and Colwell[1,2] have reported the reflection of radio waves at vertical incidence from temperature inversions in the troposphere, and have estimated the reflection coefficient to be of the order of 10^{-3} at a frequency of 2398 kc./s. On the assumption that atmospheric reflections are due to discontinuities in water content, Piddington[3] has calculated the reflection coefficient to be not greater than 10^{-4}.

The reception of ultra-short wave signals at distances of the order of 100 km. is known to be correlated with the existence of atmospheric irregularities[4], and these signal strength measurements may be used to calculate the reflection coefficient for longer waves at vertical incidence. Since the air-mass boundary occurring at a temperature inversion must occupy a finite thickness, the effect of this diffuse boundary must be taken into account.

The propagation of electromagnetic waves in a stratified medium has received considerable attention in view of its application to optics and reflections from the ionosphere[5]. In the case of tropospheric reflections, where the variations in dielectric constant are very small, the calculation is much simplified and the method adopted by Darwin[6] and Hartree[7] of integrating the wavelets scattered by each part of the medium may be readily modified to give the required result. If the dielectric constant ε of the atmosphere is taken to be a continuous function of the height z only, and the diffuse boundary extends from z_1 to z_2, the reflection coefficient for radio waves of wave-length λ incident at an angle θ is

$$\rho\,(\lambda,\theta) = \left|\tfrac{1}{4}(\sec^2\theta - A)\int_{z_1}^{z_2}\frac{d\varepsilon}{dz}\cdot\exp\left(-\frac{i4\pi z\cos\theta}{\lambda}\right)\cdot dz\right|,$$

where A is 0 for horizontal polarization and 2 for vertical polarization. At normal incidence this is equivalent to the expression given by Försterling[8]. Whatever variation with height is assigned to ε, there is a simple relation between oblique and normal incidence, namely:

$$\frac{\rho\ (\lambda\,,\ \theta)}{\rho\ (\lambda\sec\theta,\,0)} = \sec^2\theta - A.$$

The measurements of Englund, Crawford and Mumford[4] on the propagation of 4·7 metre waves over a distance of 112 km. may by this relation be used to calculate the corresponding reflection coefficients for a wave-length of approximately 160 metres at vertical incidence. The result lies between 10^{-6} and 3×10^{-5}, the upper limit being in agreement with the experimental values of Appleton and Piddington[9] for random echoes from the troposphere.

It is interesting to compare the values of reflection coefficient for diffuse and sharp boundaries. If reasonable assumptions are made as to the height variation of ε, the reflection coefficient at normal incidence falls to half that for a sharp boundary when the transition layer is about one quarter wave-length thick. For a typical case of ultra-short wave transmission at grazing incidence, where θ differs from $\pi/2$ by about 0·03 radian, the corresponding thickness is about eight wave-lengths.

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Physical Laboratory,
University College,
Southampton.
April 8.

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[1] Colwell, R. C., and Friend, A. W., NATURE, **144**, 31 (1939).

[2] Friend, A. W., and Colwell, R. C., *Proc. Inst. Rad. Eng.*, **27**, 626 (1939).

[3] Piddington, J. H., *Proc. Phys. Soc.*, **51**, 129 (1939).

[4] Englund, C. R., Crawford, A. B., and Mumford, W. W., *Bell Syst. Tech. J.*, **17**, 489 (1938).

[5] See for example, Wilcken, J. A., *Phil. Mag.*, **49**, 107 (1925). Rawer K., *Ann. Phys.*, **35**, 385 (1939).

[6] Darwin, C. G., *Trans. Camb. Phil. Soc.*, **23**, 137 (1924).

[7] Hartree, D. R., *Proc. Camb. Phil. Soc.*, **25**, 97 (1929).

[8] Försterling, K., *Ann. Phys.*, **11**, 1 (1931).

[9] Appleton, E. V., and Piddington, J. H., *Proc. Roy. Soc.*, A, **164** 467 (1938).

Blue Rocksalt

IN a letter in NATURE of February 17 under the above title, Dr. J. Newton Friend and John P. Allchin suggest that the blue colour of rocksalt may be derived from colloidal gold present in the sea-water from which the rocksalt has crystallized out, and give a content of 1 p.p.m. of gold as sufficient to produce a decided tint to a crystal.

From an oceanographer's viewpoint, it may be observed that this proportion of gold to sodium chloride would correspond to a gold content in the original sea-water of about 25 mgm./ton, whereas the highest gold content found by F. Haber and co-workers (in water from the East Greenland polar current) was 0·04 mgm./ton, the average value for the South Atlantic surface water being at least ten times less.

HANS PETTERSSON.

Oceanografiska Institutet,
Göteborg.
March 29.

Rhythmical Impedance Changes in the Trout's Egg

MANY measurements have been made in recent years of the electrical impedance of cells such as those of nerve, Nitella and of marine eggs, and it has been found that such measurements yield valuable information as to cellular structure and reactivity.

Fertilized and unfertilized trout's eggs undergo rhythmical impedance changes when they have been in water for about six hours[1]. Further experiments show that this effect is not associated with the cytochrome system, as sodium nitride, carbon monoxide and lack of oxygen do not affect it. On the other hand, suitable concentrations of phenyl urethane reversibly abolish the effect. The action of the anæsthetic is shown in Fig. 1. The recovery part of the record has been omitted as it has no features of special interest.

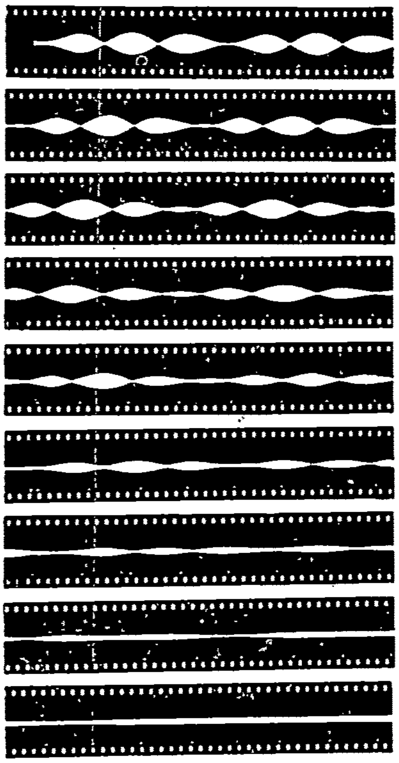

Fig. 1.

THE EFFECT OF PHENYL URETHANE ON THE IMPEDANCE CYCLE IN AN UNFERTILIZED TROUT EGG. THE ANÆSTHETIC WAS APPLIED AT THE BEGINNING OF THE RECORD. TIME-MARKER, MINUTES.

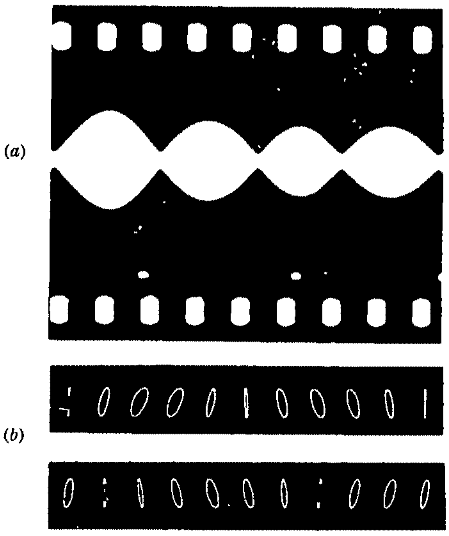

Fig. 2.

a, TWO COMPLETE IMPEDANCE CYCLES. TIME-MARKER, MINUTES.
b, SIMULTANEOUS RECORD OF THE RESISTANCE AND CAPACITANCE CHANGES IN THE EQUIVALENT CIRCUIT. THE ELLIPSES ARE 7·5 SEC. APART.

A change in impedance is due to a change in resistance and/or capacitance. (Inductances need not at present be considered in biological systems.) By using the 'ellipse' method of resolution[2], one can evaluate the resistive and capacitative components of the egg impedance cycle in the parallel circuit equivalent at a particular frequency to the trout egg in tap-water. This is shown in Fig. 2. Here, simultaneous moving film records of the impedance cycle, the resistive (R_p) and the capacitative (C_p) components are recorded. If R_p (as the angle of tilt of the ellipse) and C_p (as the minor ellipse axis) are plotted against time, the resultant curves are in phase every other cycle and approximately sinusoidal.

ROTHSCHILD.

Zoological Laboratory,
Cambridge.
March 23.

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[1] Hubbard and Rothschild, *Proc. Roy. Soc.*, B, **127**, 510 (1939).

[2] Cole, K. S., and Curtis, H. S., *J. Gen. Physiol.*, **22**, 37 (1938).

Fluorescence and Oxidation in Conjugated Ring Systems

THE study of the fluorescence of organic substances has shown that strong fluorescence is almost entirely confined to conjugated ring systems, which possess the highly mobile electrons. Theoretically, it is clear that a substance can only then exhibit fluorescence if the potential curves of the ground state and the excited state do *not* cross each other (or come very near to each other) so that the transformation of electronic excitation energy into heat cannot occur.

Thus the essential conditions for fluorescence are: (1) the excitation of the electron must not change appreciably the internuclear distance; (2) there must be no favoured position for the electron where it can be 'trapped' and thereby its kinetic energy transformed into potential energy.

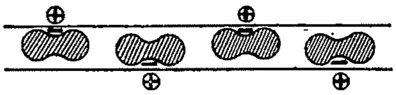
Consequently, only the more symmetrical conjugated systems or those which do not give rise to strongly ionic structures will show intense fluorescence.

The increase of the number of 'mobile' electrons, for example, in the series benzene → naphthalene → anthracene → . . . . → graphite, makes them behave increasingly like 'metallic' electrons as regards their optical and electrical behaviour.

We have found that this analogy to a metal can also be applied to some extent to the chemical structure and the reactivity of conjugated ring systems in general. It should be possible to prepare stable *positive ions* from the more 'metal-like' hydrocarbons by the action of oxidizing agents, and these positive ions should be capable of forming salt-like compounds. Various ionic compounds (bisulphate, perchlorate, etc.) have actually been prepared more recently from graphite by Hofmann[1] and collaborators by acting on it with an oxidizing agent in the presence of strong acids (sulphuric, perchloric). A certain number of hexagons in the layer planes loose an electron to form a monovalent positive (macro)-ion and this ion combines with HSO_4^- or ClO_4^- ion which goes between the layer planes of the graphite.

In view of the above-mentioned analogies with the metals, there can be no doubt that at least some of the peroxides of highly conjugated hydrocarbons, and in particular graphitic oxide, are essentially of ionic nature. The general formula of these compounds is most probably $[(\text{Hydrocarbon}+)O_2^-]$. They are sometimes formed in a thermal reaction as in the case of triphenyl methyl[2], giving $[(C_6H_5)_3C+.O_2^-]$. In the case of the diamagnetic hydrocarbons (for example, rubrene[3] or 3 : 10 dimethyl 1 : 2 benzanthracene[4], the peroxide is only formed under the influence of light, which decreases the ionization potential in the excited state and thus helps the formation of a positive ion.

The existence of O_2^- ion in peroxides like KO_2 has been shown by Pauling and Neuman[5] and its electronic structure has been discussed in detail[6]. Graphitic oxide should then be considered as a salt similar to the other graphite salts where the anion HSO_4^- or ClO_4^- is now replaced by O_2^- (or possibly partly by HO_2^-) (see diagram). This structure, of course, only refers to the '*active*' *oxygen* in graphitic oxide. The rest of the oxygen is present partly in the form of OH groups (possibly OH-ions) or as molecular water.



SCHEMATIC REPRESENTATION OF THE STRUCTURE OF GRAPHITIC OXIDE (SHADED PARTS REPRESENT O_2^- IONS BETWEEN THE LAYER PLANES OF THE GRAPHITE).

The ionic nature of graphitic oxide is also confirmed by the observed distance of layer planes, and by the fact that interplanar swelling can only be effected by *polar* solvents[1], a fact which was not understood previously.

The positive ions of graphite can be easily reduced[1] (reversibly) again to graphite, and this is also true for some of the hydrocarbon-peroxides which are decomposed by light or heat giving the unchanged ring systems.

Conjugated systems are of great biological interest and their biological significance seems to lie in the fact that they can undergo reversible oxidation, as has been made very probable in the case of chlorophyll[7]. The carcinogenic hydrocarbons also belong into the group of fluorescent conjugated ring systems[8] and it is quite possible that the oxido-reduction of these 'metal-like' hydrocarbon ions, namely,

$$(\text{Hydrocarbon}+)\underset{\text{oxidation}}{\overset{\text{reduction}}{\rightleftarrows}}(\text{Hydrocarbon}),$$

is an essential factor in causing the abnormal metabolism.

A full account will be published elsewhere.

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March 21.

[1] Hofmann, U., *Ergeb. exact. Naturwiss.*, **18**, 229 (1939).
[2] Ziegler, K., and Ewald, L., *Ann. Chem.*, **504**, 162 (1933).
[3] cf. Dufraisse, C., *Bull. Soc. Chim.*, (5) **16**, 422 (1939).
[4] Cook, J. W., Martin, R., Roe, E. M. F., NATURE, **143**, 1020 (1939).
[5] Neuman, E. W., *J. Chem. Phys.*, **2**, 31 (1934).
[6] Pauling, L., *J. Amer. Chem. Soc.*, **53**, 1367, 3225 (1931).
[7] Rabinovitch, E., and Weiss, J., *Proc. Roy. Soc.*, A, **162**, 251 (1937).
[8] cf. Cook, J. W., NATURE, **145**, 335 (1940).

Ionization of Calcium Phytate

IT has been pointed out by Bruce and Callow[1], and again recently by Harrison and Mellanby[2], that the rachitogenic property of cereals may be due to the formation of a sparingly soluble salt of phytic acid and calcium. In this laboratory, investigations on the chemical properties of this compound have shown that sodium phytate can only form an insoluble precipitate when an equivalent or an excess of calcium is added. Under such conditions the filtrates are clear and contain only a trace of phytic acid. When less than half the equivalent quantity of calcium is added, no precipitate is formed and the solution remains clear. *The calcium in the solution is not precipitated by the addition of phosphate or oxalate.* This indicates complex ion formation, and also that the degree of ionization of free calcium is extremely small. When the amount of calcium is between one half and one equivalent the solution is turbid and difficult to filter.

The magnesium ion reacts with sodium phytate in the same way. When a mixture of calcium and magnesium ions is added in excess of that required by the phytate, magnesium can take the place of the calcium in the precipitate to a certain extent.

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Jan. 30.

[1] Bruce, H. M., and Callow, R. K., *Biochem. J.*, **28**, 517 (1934).
[2] Harrison, D. C., and Mellanby, E., *Biochem. J.*, **33**, 1660 (1939).

WITH reference to the above letter, we should like to point out that we showed in a recent paper on phytic acid and the rickets-producing action of cereals[1], that the greater part of the calcium in a hydrochloric acid extract of oatmeal is, in fact, precipitated as phytate on bringing the solution to the neutral point, even though the total amount of calcium present is much less than equivalent to the phytic acid in the solution. Possibly the magnesium which is also present in the extract assists in the precipitation of calcium by forming an insoluble magnesium-calcium phytate instead of a soluble sodium-calcium double salt[2] which may be formed under the conditions described by Yang. Unfortunately, he does not state the hydrogen ion concentration under which his observations were made.

We found, too, that the filtrate from the neutralized oatmeal extract still contained a small amount of calcium in solution in spite of the presence of excess of phytic acid, and that addition of further amounts of calcium caused precipitation. We suggested that the residual soluble calcium was probably in an unionized form and therefore nutritionally unavailable. The observations of Yang appear to lend support to this suggestion, though as stated in our paper, we feel that there is not sufficient evidence to decide whether phytic acid exerts its rickets-producing action by actual precipitation of calcium or by lowering the ionization and diffusibility of calcium of the food. It seems possible that it may act in both ways, the depression of ionization being of relatively more importance at a faintly acid intestinal pH where precipitation of calcium would be less great.

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[1] Harrison, D. C., and Mellanby, E., *Biochem. J.*, **33**, 1660 (1939).

[2] Posternak, S., *Helv. chim. Acta*, **4**, 150 (1921).

Action of Œstrogens on the Female Genital Tract

IN an attempt to elucidate the mode of action of œstrogens on the female genital tract, we have conducted tests with cover-slip cultures of rat vagina and uterus.

Fragments of vagina from young albino females about three weeks old were explanted in the following media: (*a*) normal male rat serum; (*b*) normal male rat serum diluted with (i) 25 per cent of distilled water, or (ii) 25 per cent of an aqueous solution of diethylstilbœstrol containing 7·5 μgm. per ml.; (*c*) male rat serum ground up with a few crystals of œstradiol and filtered.

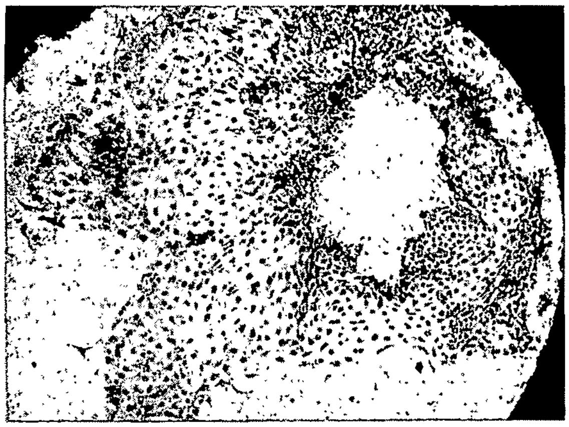

FIG. 1.

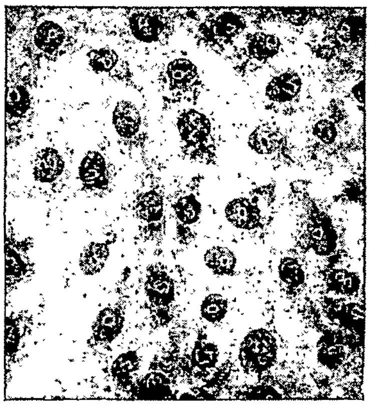

FIG. 2.

Six cultures were prepared with each type of medium. The explants became rounded after twenty-four hours. Afterwards some desquamation of the epithelium occurred, but there was little cellular outgrowth. After three and after four days, explants were fixed and sectioned. No histological difference was detectable between those incubated in the different media. There were very few mitoses in the epithelial cells, and no indication of active proliferation or cornification having occurred.

A further series of cultures was set up in a medium composed of equal parts of chick embryo extract, and a mixture of three parts of rat plasma to two parts of fowl plasma. Fragments of the uteri and vaginæ of five-day-old rats were explanted. After twenty-four hours incubation there were outgrowths of sheets of epithelial cells from most of the uterine explants, but the vaginal explants showed less growth. The cultures of each tissue were then divided into four sets of six cultures, *A*, *B*, *C* and *D*, exhibiting approximately equal growth from set to set. Different treatments were then given to the cultures of the four sets. *A* received a drop of arachis oil, *B* a drop of arachis oil containing 1·0 mgm. of œstradiol per ml., *C* a drop of distilled water, and *D* a drop of distilled water containing *ca.* 50 μgm. of colloidal œstradiol per ml.

Cultures were fixed 24, 48, and 96 hours after treatment for cytological examination. However, the hormones had no demonstrable action, and there was no difference between the various sets of the same tissue.

The type of culture with which we have been working is illustrated in Fig. 1, the explant having been removed after fixation. This represents four days growth *in vitro*, and two days treatment with a drop of distilled water. Fig. 2 shows at a higher magnification a part of a similar culture after treatment with colloidal œstradiol for two days. Both of the cultures were of uterine fragments. We are satisfied that the cultures were brought in contact with more than sufficient œstrogen to cause the changes characteristic of œstrogenic stimulation *in vivo*, and in view of the healthy state of the cultures, it appears improbable that œstrogens act directly on the vaginal or uterine epithelia.

While this work was in progress, Hechter, Lev and Soskin[1], following the work of Reynolds[2] and Pompen[3], showed that vaginal cornification in the mouse produced by œstradiol benzoate may be inhibited by atropine, and that cornification follows the administration of yohimbine. The uterine response was only partially inhibited by atropine. Hechter and his co-workers believe that the vaginal response, and part of the uterine response to œstrogens, is dependent upon hyperæmia, a conclusion which is complementary to our own, since we found no indication of a direct action of œstrogens upon the epithelial cells.

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[1] Hechter, O., Lev, M., and Soskin, S., *Endocrinology*, **26**, 73 (1940).

[2] Reynolds, S. R. M., *J. Physiol.*, **95**, 258 (1939).

[3] Pompen, A. W. M., "De Invloed van Menformon op der Baarmoeder". Thesis. Amsterdam, quoted by Reynolds (1933).

'Coupling' of Phosphorylation with Oxidation of Pyruvic Acid in Brain Tissue

Lipmann[1] found that, although adenylic acid does not influence the rate of oxidative decarboxylation of pyruvic acid by preparations of lactic acid bacteria, it is phosphorylated to adenosine-polyphosphate. With brain dispersions it has been shown in this laboratory[2] that oxidation of pyruvate requires the presence of both inorganic phosphate[3] and adenine nucleotide (adenylic acid, adenosine-triphosphate). These observations suggested that a cycle of phosphorylation is involved in the enzymatic oxidation of pyruvate.

Brain preparations contain an active adenosine-triphosphatase[2] and, in the presence of adenylic acid (without or with creatine), only small amounts of adenosine-polyphosphate (or creatine phosphate) accumulate. However, that oxidation of pyruvate in brain tissue is accompanied by an intensive esterification of phosphate has now been shown by using hexosemonophosphate as an acceptor for the labile phosphorus groups of adenosine-triphosphate[4]. When hexosemonophosphate is added to a dialysed brain dispersion containing phosphate, Mg^{++}[5], adenylic acid, fumarate[2], pyruvate, and NaF (phosphorylation also occurs in the absence of NaF), and the mixture is incubated aerobically, inorganic phosphorus is taken up (Table 1) and an equivalent amount of hexosemonophosphate is converted into hexosediphosphate. As much as 0·8 mgm. hexosemonophosphate phosphorus can thus be phosphorylated in 35 min. at 38°. The hydrolysis curve (in *N* HCl at 100°) of the resulting ester is that of hexosediphosphate which, under these conditions, does not seem to react further significantly; this is confirmed by the failure to detect formation of phosphoglyceric acid by Rapoport's[6] method. No esterification of phosphate occurs in the absence of pyruvate plus fumarate and very little in the absence of adenylic acid. Thus oxidation of pyruvate is accompanied by phosphorylation of adenylic acid to adenosine-polyphosphate which, in presence of hexosemonophosphate, transfers its labile phosphorus to the latter instead of being hydrolysed by the adenenosine-triphosphatase. Table 2 shows that, in 30 min., approximately 2 atoms phosphorus are esterified for 1 mol. pyruvate disappearing and 1 mol. oxygen taken up.

Table 1.

1·5 ml. dispersion from pigeon brain (dialysed 2·5 hours) to 2·2 ml. with phosphate buffer *p*H 7·3 (0·05 *M*) Mg^{++} (0·2 mgm.), adenylic acid (0·0007 *M*), Na fumarate (0·005 *M*), Na pyruvate (0·013 *M*) and NaF (0·04 *M*). Air, 38°.

(O_2 uptake = difference between complete samples and samples containing no pyruvate + fumarate).

Time (min.)	O_2 uptake (μ 1)	Pyruvic acid (mgm.)	Inorg. Phosphorus (mgm.)
0	—	2·17	1·42
5	48	1·62	1·13
10	96	1·51	1·00
20	143	1·34	0·92
30	190	1·24	0·83

Table 2.

Time (min.)	O_2 uptake		Pyruvic acid disappeared		Phosphorus esterified	
	μ 1	μ mol.	mgm.	μ mol.	mgm.	μ atoms
30	190	8·5	0·93	10·5	0·59	19·0

The necessity of inorganic phosphate and adenine nucleotide for the oxidative breakdown of pyruvate in brain is thus explained. The recent work of Warburg and Christian[7], by which the mechanism of enzymatic oxidation of triosephosphate and the true nature of the 'coupled' esterification of phosphate are made clear, will throw much light upon the undoubtedly similar mechanism of pyruvate oxidation.

I am indebted to the Nuffield Trustees and the Rockefeller Foundation for grants in aid of this work.

S. Ochoa.
Department of Biochemistry,
Oxford.

April 11.

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[1] Nature, **143**, 281 (1939).

[2] Banga, Ochoa and Peters, Nature, **144**, 74 (1939); *Biochem. J.*, **33**, 1980 (1939).

[3] cf. Lipmann, *Enzymologia*, **4**, 65 (1937) as regards bacteria.

[4] Ostern, Guthke and Terszakowec, *Z. physiol. Chem.*, **243**, 9 (1936).

[5] Ochoa, Nature, **144**, 834 (1939).

[6] *Biochem. Z.*, **291**, 429 (1937).

[7] *Biochem. Z.*, **303**, 40 (1939).

Influence of Spermathecal Stimulation on the Physiological Activities of *Anopheles subpictus*

The introduction of spermatozoa into the spermatheca is not known to influence the physiological activities of a mosquito or of any other insect except that it serve [illegible]he purpose of fertilization of the ovum. That it h [illegible] arked action on egg formation in *Anoph* [illegible] has now been demonstrated.

W [illegible] ating of *A. stephensi* and *A.* [illegible] in ordinary feeding cages ir [illegible] do not pair under s [illegible] lso been noted feed to the same extent as in Nature. While a blood feed will lead to egg formation in virgin *A. stephensi* and *A. annularis*, it fails to do so in virgin *A. subpictus*, even when this mosquito has been allowed to feed to repletion on man, goat, or cattle, and evidence of follicular stimulation is the only noticeable change. This led Christophers[1] to abandon his observations on egg development in *A. subpictus* in the laboratory.

The presence of two distinct phases in the egg formation in *Aedes aegypti*, one stimulation of the follicle and the other formation of the ovum, was tentatively suggested by me[2]. The stage of follicular stimulation can be clearly demonstrated in *A. subpictus*, and is characterized by the appearance of very light peppery granules scattered irregularly. These are distinct from yolk granules, which are much coarser and are deposited in a much more compact manner. Distinction between these two stages in *A. annularis* is not possible unless the latter are allowed to ingest a very small quantity of blood, as otherwise the second phase overlaps the first.

It has also been observed in *A. subpictus* caught in Nature that ingestion of a large quantity of blood and yolk formation are solely dependent on the presence of sperms in the theca.

While reception of blood into the stomach is sufficient to cause stimulation of the follicles and yolk formation in virgin *A. annularis*, and only the former change in virgin *A. subpictus*, the introduction of sperms into the theca in the latter species can alone lead to yolk formation. The specific substance of the blood which is concerned with yolk formation in *A. subpictus* is intimately associated with the stimulation of the theca, and it is presumed a specific hormone is thereby produced.

Any suggestion that the failure of laboratory-fed *A. subpictus* to produce yolk owing to the ingestion of a smaller quantity of blood than the minimum amount necessary for egg production is untenable on account of the constant association between yolk formation and the presence of sperms in the theca, and also the reverse phenomenon noticed in mosquitoes caught in Nature[2]. Besides, the amount of blood ingested by *A. subpictus* in the laboratory does not seem to be insufficient for egg production.

Collections of the mosquitoes, *A. annularis* and *A. subpictus*, were made from the salt-lake area adjacent to Calcutta, and dissections were performed from day to day. Nearly five hundred specimens of each species were dissected.

The above conclusions have been arrived at from observations made during the winter months.

D. N. ROY.

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Calcutta.
Feb. 27.

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[1] Christophers, S. R., Paludism. Government Central Branch Press, Simla (1911).

[2] Roy, D. N., *Bull. Ent. Res.*, 27, 423-429 (1936).

Photodynamic Hæmoly [illegible] 4-Benzpy [illegible]

IN a recent com [illegible] d
the photodyn [illegible] s
[illegible]
closely with Wolman's. But we varied and further extended the experiments in order to try to see how benzpyrene sensitizes red corpuscles. We have carried out the following investigations.

(1) Colloid solutions of benzpyrene in normal saline were made up in a series of dilutions from 1 in 10,000 to 1 in 100 million. Washed human red corpuscles were added to these and the mixtures kept in the dark for three hours. Some were then put in sunlight and controls kept in the dark. After 45 minutes exposure the red corpuscles in the 1 in 10,000, 1 in 100,000, and 1 in 1 million solutions showed approximately the same amount of partial hæmolysis. This was complete in two hours, by which time a partial hæmolysis was present in the 1 in 10 million solution. There was no hæmolysis in the 1 in 100 million solution in the light and none in the controls kept in the dark.

(2) Colloid benzpyrene solutions were given a prolonged exposure to light. Red corpuscles were then added and the mixtures kept in the dark. No hæmolysis resulted.

(3) Suspensions of red corpuscles in benzpyrene colloid were left in the dark for various times and the corpuscles then washed free from benzpyrene. After this they were given a long exposure to light. Corpuscles which had been in contact with the hydrocarbon for five minutes showed a trace of hæmolysis, those in contact for one hour showed moderate hæmolysis, and corpuscles which had been in contact with the benzpyrene for three hours showed complete hæmolysis, in 45 minutes exposure to sunlight. The strength of the colloid was 1 in 100,000.

(4) Samples of red corpuscle suspensions in benzpyrene colloid (1 in 250,000) kept for 2½ hours in the dark at various temperatures were washed and exposed to light. Those which had been kept in contact with the benzpyrene at 0° C. showed only slight hæmolysis after prolonged exposure to a mercury vapour lamp. Red corpuscles which had been in contact at 37° C. showed a comparatively rapid hæmolysis under the lamp.

Thus, using red corpuscles, the photodynamic potency of benzpyrene is roughly the same in dilutions of 1 in 10,000 to 1 in 1 million. Paramecia gave a similar result (Doniach[2]). Washing red corpuscles which have been suspended in benzpyrene does not get rid of their sensitivity to light. This sensitivity is enhanced by prolonged contact with the hydrocarbon and by raising the temperature at which the corpuscles are suspended in the colloid. These results indicate that the benzpyrene must enter into the red corpuscles before a photodynamic action can start. If it were a matter of simple adsorption on to their surface one would have expected contact at 0° C. to have been more effective than contact at 37° C. The enhancement at higher temperature is likely to be due to an increased solubility of the benzpyrene in water, an assumption in accord with recent results of other experiments in this laboratory.

I. DONIACH.
J. C. MOTTRAM.

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Northwood, Middlesex.
April 20.

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[1] Wolman, M., NATURE, 145, 592 (1940).

[2] Doniach, I., *Brit. J. Exp. Path.*, 20, 227 (1939).

Acetolysis of Carrageen Mucilage

IN a series of papers published between 1921 and 1929, Haas and his collaborators[1] showed that in the mucilage of carrageen moss (*Chondrus crispus*) there are two main constituents one of which can be extracted from the seaweed by cold water, the other only by hot water. They further showed that both constituents are ethereal sulphates of polymeric carbohydrates, occurring chiefly in the form of their calcium salts; but all their attempts to isolate the polymeric carbohydrates by hydrolysis led only to the production of simple hexoses. Galactose and fructose were easily recognized by them among the products of hydrolysis.

We have now acetylated the mucilage by treatment with acetic acid and acetic anhydride under the catalytic action of sulphur dioxide and chlorine, and on removal of the acetyl groups from the product we have obtained two polymeric carbohydrates each containing about 0·1 per cent of ash and giving analyses which agree well with the formula $(C_6H_{10}O_5)_n$. One of these bodies is soluble only in hot water and gives with iodine a wine-red colour similar to that given by glycogen, while the other is soluble in cold water and gives no characteristic colour with iodine. After hydrolysis neither compound gives glucosazone nor does either give the Seliwanoff reaction for fructose; the latter reaction is, however, given by the alcoholic liquid from which the polymeric carbohydrates have separated on deacetylation. From both polymers the characteristic α-methylphenylhydrazone of galactose was prepared and both gave mucic acid on oxidation with nitric acid.

Both polymeric carbohydrates appear to be galactans. In physical properties they resemble the body isolated by Hassid[2] from *Irideæ Laminarioides* more than that obtained by Percival and Sym[3] from agar.

Further investigation of these products is in progress, and detailed results will be published elsewhere.

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P. O'COLLA.

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March 30.

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[1] Haas and Hill, *Ann. App. Biol.*, 7, 352 (1921); Haas, *Biochem. J.*, 15, 469 (1921); Russell-Wells, *Biochem. J.*, 16, 578 (1922); Haas and Russell-Wells, *Biochem. J.*, 23, 425 (1929).

[2] Hassid, *J. Amer. Chem. Soc.*, 57, 2046 (1935).

[3] Percival and Sym, NATURE, 137, 997 (1936).

Points from Foregoing Letters

A NEW formula connecting tensile strength with latent heat of melting and Poisson's elastic constant has been developed by R. Fürth and found to be in good agreement with experiment.

Electron diffraction studies show, according to S. Yamaguchi, that when potassium and sodium are exposed to air they are attacked within five minutes by carbon dioxide, but lithium and calcium are not attacked. Oxygen and moisture in the air attack all four metals.

W. Krasny-Ergen describes a suggested apparatus for the separation of uranium 235.

L. G. Stoodley has shown how measurements of the signal strengths of ultra-short waves reflected at grazing incidence at a diffuse boundary in the troposphere may be used to calculate the reflection coefficient for longer waves at vertical incidence. The results are in agreement with the experimental values of Appleton and Piddington.

Records of the rhythmical impedance changes undergone by an unfertilized trout egg are submitted by Lord Rothschild. From resistance and capacitance changes in an equivalent circuit, it is found that resistance and capacitative components plotted against time give curves which are in phase every other cycle and approximately sinusoidal.

J. Weiss states that the fluorescence of conjugated ring systems is essentially due to the presence of the 'mobile' electrons, which are also responsible for the chemical behaviour of these substances. The structures of some related hydrocarbon-peroxides and of graphitic oxide are deduced, and a possible mechanism for the action of carcinogenic hydrocarbons is suggested.

E. F. Yang finds that when sodium phytate is present in excess, calcium is not precipitated as the phytate but remains in solution in an un-ionized form which is not precipitated by addition of oxalate or phosphate. D. C. Harrison and Sir Edward Mellanby find that this non-precipitation of calcium as phytate does not hold for oatmeal extracts. Their experiments indicate that the rickets-producing action of cereals is due to phytic acid, which interferes with calcium absorption from the intestine. They suggest that the cereal phytic acid may exert a rachitogenic action partly by precipitating calcium in the intestine and partly by rendering the calcium un-ionized and thus impeding its absorption.

The application of œstrogens by C. W. Emmens and R. J. Ludford to tissue cultures of vagina and uterus failed to induce either proliferation or cornification of the epithelial cells. Hence it is concluded that the characteristic histological changes following œstrogenic stimulation *in vivo* are not the result of a direct action of the hormones on the epithelial cells.

S. Ochoa finds that oxidation of pyruvic acid in brain preparations, in the presence of phosphate, adenylic acid, and hexosemonophosphate, is accompanied by conversion of the monoester into hexosediphosphate with an equivalent uptake of inorganic phosphorus. This 'coupling' explains why both inorganic phosphate and adenylic acid are necessary for the oxidation of pyruvate in brain.

I. Doniach and J. C. Mottram report that human red corpuscles were sensitized to light with 3 : 4-benzpyrene. The hydrocarbon was active down to a dilution of 1 in 10 million. Washing red corpuscles which had been suspended in benzpyrene colloid did not rid them of their sensitivity to light. The photodynamic reaction was enhanced both by prolonged contact in the dark of the corpuscles with the benzpyrene and by raising the temperature at which contact was made.

By acetolysis of carrageen mucilage, T. Dillon and P. O'Colla have obtained two polymeric carbohydrates, one soluble in cold water and the other soluble in hot water and giving a characteristic colour with iodine. Both appear to be galactans.

RESEARCH ITEMS

Fertility Cults in East and West

A POSSIBLE link between the Mediterranean and adjacent regions of the ancient world and Japan in the symbolism of the cowrie as a fertility emblem is discussed by Kurt Singer (*Man* of April 1940). While Elliot Smith's theory of the cowrie as a "life-giver" and closely associated with parturition and other fecundity cults has been accepted, for example, by J. Gunnar Andersson, as a working hypothesis making it possible to range under a single point of view all the varying uses of the cowrie, a difficulty is that no Neolithic figurine of the Astarte type shows any recollection of the cowrie talisman. The Western evidence in figurine and cult observances is suggestive rather than conclusive, but a Neolithic (*Jōmon*) figurine from north-eastern Japan is unique in showing not only unusually strongly accented breasts, but also what appears to be a monstrous vulva but is probably the giant image of a cowrie shell hanging from a cord attached to the neck-band. The ritual use of powdered shell and water for various ceremonies may also be thought to confer life and force by administering a simulacrum of mother's milk produced from a simulacrum of the womb. Two masks recall the traditions about Baubo-Iambe and Demeter. They formed the central part of the autumn procession at the festival of the Gongoro Jinja in Kamakura, and were worn one by a woman showing signs of distraction and the other by a woman obviously with child who addressed ribald remarks to male onlookers. The procession closed with men carrying poles, recalling phallic symbols. Arguments and parallels may be cited in support of the suggested resemblance to Demeter and Baubo.

Stomatopoda from the John Murray Expedition

Two memoirs on the Stomatopoda have recently appeared (John Murray Expedition, Scientific Reports 6, No. 3, by B. Chopra, No. 6, by G. E. H. Foxon. British Museum (Natural History), 1939). The collection of Stomatopods is small but of interest. Some are of large size, more than 300 mm. in length. Sixteen species and varieties are recorded, one species of Squilla and one of Lysiosquilla being new. The variation in the raptorial teeth in *Squilla investigatoris* is remarkable; also the variation of the relation of rostrum to eyes in *Lysiosquilla multifasciata*. There are many varieties of *Gonodactylus chiagra*, some of which are regarded as distinct species. A small one was dredged at the unusual depth of 1,300 m. Fragments of *Squilla investigatoris* were also dredged at this depth, but it is, of course, not certain that the species was actually living there—a record depth for any Stomatopod. It is difficult to place the new species *Lysiosquilla sewelli*, which combines characters of this genus with those of several others. In his work on the larvæ, Foxon has modified his former classification (1932, Great Barrier Reef Report) which has been criticized by Guerney (*Proc. Zool. Soc.*; 1937) who regards the classification of Giesbrecht as the more natural one in which the two fundamental types of larva, antizoea and pseudozoea are separated. The revised key gives two main groups, the first containing Coronida and Lysiosquilla (antizoea larva), the second containing all the others. In the second group Squilla and Pseudosquilla are placed close together, in agreement with the adult classification of Kemp, and Odontodactyla and Gonodactylus which have early larvæ very similar to Pseudosquilla and different from Squilla, in another section. It is shown that Squilla larvæ occurred everywhere, but in great numbers near the coast. Pseudosquilla larvæ are likely to be found near land, and Lysiosquilla larvæ are the most likely to be found farthest from land.

Turbellaria from Bermuda and the Sargassum

L. H. HYMAN has recently described a valuable collection of Acoel and Polyclad Turbellaria derived from material collected by herself, by Dr. Wheeler and by Dr. Verrill in Bermuda, and also several Sargassum collections from the Bingham Oceanographic expeditions to the western and central North Atlantic, the Gulf of Mexico and the Caribbean (*Bull. Bingham Oceanograph. Coll.*, Peabody Museum of Natural History, Yale University, 7, Art. 1; 1939). Nine plates of clear drawings illustrate this paper, in which there are two new species of Acoela, eleven known and two new species of Polycladida, and one new variety of Polyclad. Many of these were collected on the shore at Bermuda, but there are also species from the floating Sargassum weed which is a fruitful hunting ground for these worms. The Polyclads are chiefly species originally described by Verrill in 1900 and 1901 and these are now assigned to their proper genera with details of their sexual anatomy. Use has been made of colour drawings made from live specimens by Dr. Wheeler, director of the Bermuda Biological Station, which makes the descriptions doubly valuable; the whole monograph forms a useful addition to the rapidly growing series of writings on the Bermudan fauna.

Identification of Plants of Tanganyika Territory

"A FIELD Key to the Savanna Genera and Species of Trees, Shrubs and Climbing Plants of Tanganyika Territory" by the late B. D. Burtt (published by the Tsetse Research Department) should prove extremely valuable to workers in this part of Africa, where it is difficult to get plants named locally, especially as the collections are housed in European herbaria. Many of the workers in Tanganyika are attached to technical departments, and the key will have added value from the fact that its use does not require a preliminary botanical training, so that anyone dealing with plants as indicators of soil conditions, timber trees or plants with poisonous or useful properties will be able to record his observations in the concrete form of a correct botanical name. Though primarily concerned with plants of Tanganyika, the savannah plants are very similar in the neighbouring parts of Northern Rhodesia Nyasaland, Uganda and Kenya, so that, with reservations, the key may be applicable to the savannahs of these districts or serve as a basis for a similar key. It is much to be regretted that Mr Burtt's death has interrupted this work, of which he had outstanding knowledge, but it is to be hoped that in time the key to the genera will be supplemented by a key to the species as originally intended.

A Fossil Link between North America and Asia

A MAIL report from Science Service and the Smithsonian Institution announces the clarification of a problem which has long puzzled American geologists. Large numbers of fossil leaves which somewhat resembled the foliage of living poplars have been collected between Greenland and south-western Tennessee, for the past seventy years. Roland W. Brown suggests that the leaves are similar to those of a present-day Japanese tree, the katsura. He further argues that if leaves were fossilized through being blown into mud, it ought to be possible to find also the fossil seeds. Katsura seeds have sickle-shaped wings and are wind-blown. Dr. Brown ultimately found a few of them fossilized in the localities where the fossil leaves occurred. A study of variation in leaf form of the present-day tree paralleled the various types of fossil foliage. This brilliant piece of palæontological investigation adds yet another to the fossil links, such as those of the horse, which bind North America and Asia.

Genetics of the Garden Pea

GENETICAL experiments with the edible pea, *Pisum sativum*, have been carried on since the time of Mendel. Nevertheless, the linkage relationships of even the well-known characters, round-wrinkled seeds or yellow-green cotyledons, are insufficiently known. C. Pellew (*J. Genetics*, 39, 363–390; 1940) has published some of her extensive linkage data. She shows how reciprocal translocations and trisomics enable us to identify the chromosomes and positions on the chromosomes where a particular gene is placed. The *K* reciprocal translocation of Hammerlund has been used for the present report. The genes, *A*, *I*, *Gp*, *Fs*, *R*, and *Bt* have cross-over percentages of 1, 1, 1, 20, 40, and 40, respectively, with the point of interchange. In normal lines *A-L* has 12 per cent crossing-over, *R-Bt* 30 per cent, and *Fs-Sp* about 42 per cent. Between these pairs of genes independence is shown in normal lines; but experiments with several translocations indicate that *A*, *L*, *R*, and *Bt* are all on chromosome 1. *Fs* and *G-p* are on chromosome 2, which with chromosome 1 took part in the *K* reciprocal translocation. The author also shows that competition and possibly elimination of certain types take place in the male gametophyte and in the young sporophyte.

Oxygen Isotopes in Rocks and Ores

A STUDY of Grenville marble, Niagara dolomite and Pennsylvania limestone and shells, all carbonates of widely different ages, made by M. Dole and R. L. Slobod (*J. Amer. Chem. Soc.*, 62, 471; 1940), reveals no significant difference in the ratio of the oxygen isotopes ^{16}O and ^{18}O as a function of the age of the rocks. The oxygen in iron ores of the Keewatin and Middle Huronian ages does not differ significantly in isotopic composition from the oxygen in normal water; the slight excess density observed in experiments on the oolitic and fossil type of Silurian ores is probably due to the presence of carbonates in the ores. The oxygen of Grenville marble when liberated as carbon dioxide and reduced with hydrogen gives water 9·2 p.p.m. heavier than normal, but when the carbon dioxide is driven out of the rock by heating, the resulting water is only 7·9 p.p.m. heavier. The difference is attributed to the isotopic fractionation which occurs when the carbonate ion is decomposed by acid. The authors discuss the question as to whether the isotope ratio corresponds with sea-water or rain-water.

X-Ray Diffraction of Liquid and Plastic Sulphur

THE anomalous behaviour of liquid sulphur in respect of viscosity, specific gravity, surface tension, thermal expansion, and specific heat at just above 150° has invited a study of the structure of liquid sulphur at different temperatures. Various workers have attempted to explain these anomalies on the basis of X-ray diffraction patterns, but recorded data are not consistent. In a recent publication (*J. Chem. Phys.*, 8, 29; 1940) Gingrich has attempted to clarify the position. He obtained and compared the X-ray diffraction patterns of liquid sulphur at eight temperatures between 124° and 340° and, in addition, that of plastic sulphur at room temperature. The intensity curve, as a function of $(\sin \theta)/\lambda$, for plastic sulphur is typical of an amorphous substance and shows three peaks. Those for liquid sulphur, corrected for absorption, polarization, and incoherent radiation, at 124°, 166°, 175°, 225°, and 340° show a main peak with two plateaux. The position of this peak shifts irregularly with temperature. Thus from 124° to 157° the value of $(\sin \theta)/\lambda$ decreases slightly, from 157° to 166° it gives a large decrease, and from 166° to 340° it decreases gradually. Atomic distribution curves show that (i) the first concentration of sulphur atoms in plastic sulphur is at 2·08 A. with two nearest neighbours, and (ii) 1·7 nearest neighbours are found at an average distance of 2·07 A. in liquid sulphur at all temperatures. (i) does not yield enough information to distinguish between closed rings of sulphur atoms and long coiled chains in plastic sulphur; and (ii) indicates that in liquid sulphur most atoms (about 70 per cent) still have two permanent neighbours which are covalently linked at the same distance as in the S_8 molecule, and about 30 per cent have one nearest neighbour.

The Mohammedan Calendar and the New Moon

J. H. REYNOLDS has discussed in a paper entitled "The Mohammedan Calendar and the First Visibility of the New Moon in Egypt" (*Occas. Notes Roy. Astro. Soc.*, No. 7; 1939) the months of the fast of Ramadan and the feast of Bairam, which commence when the thin crescent of the new moon is first visible after sunset. At the Helwân Observatory, two assistants are delegated to report both the beginning and ending of the month of the Ramadan fast, but sometimes a village sheikh in Upper Egypt or the Delta sends a wire to the Quadi's court announcing his discovery of the crescent. Occasionally the date of the alleged observation is known at the Observatory to be impossibly early. Reynolds applies J. K. Fotheringham's table (*Mon. Not.*, 70, 527; 1910), which shows the minimum true altitude at sunset or sunrise for the moon to be visible for true differences between the azimuths of the sun and moon, the latter ranging from 0° to 23°. While Fotheringham claimed that the table is independent of the latitude differences, Reynolds does not accept this view, and expresses the opinion that the table is probably inapplicable for latitudes of 50° and above. He suggests that the point would be worth verifying by observation, because of the importance of such factors as refraction and transparency of the atmosphere near the horizon.

ELECTRIC CABLES AND FIRE RISKS

MR. S. W. MELSOM, of the Cable Makers' Association, read a paper on March 13 on recent developments and investigations on electric cables and fire risks, before the Transmission Section of the Institution of Electrical Engineers.

During the last four years there has been general concentration on the problem of fire risks in electrical installations and on the precautions necessary to eliminate them. These problems, which apply to ships, power stations and mines, are probably mostly due to the immense spread of the use of electrical energy and the enormously increased size of the power units and of the distribution units and the distribution systems. As a result of the various inquiries that have been held, the encouraging news has emerged that nowadays the fire risk due to faulty cables is exceedingly small, so small, in fact, that it may almost be ignored, and that, as regards cables, the real precautions to be taken are in respect of the spread of extraneous fire along the cable.

So far as ships are concerned, shipping records justly direct attention to the excellent record of British shipping in this respect. Regarding power stations, the report of the Electricity Commissioners does not ask for any special protection from fires arising within cables, and as for mines, all the evidence of fires in mines has exonerated cables. However satisfactory the general volume of proof may be, it will be obvious that the cable-making industry was bound to make all possible investigations and, in particular, to help in the solution of the problem of resisting the spread of an extraneous fire along a cable run.

The author said that a great deal of work has recently been done on the fireproofing of mains cables in power stations, generally with the view of protecting them from breakdown due to adjacent cables, more particularly in the manholes which are part of the large duct systems prevalent in the United States. It was not until 1937 that the subject was given serious consideration in Great Britain. The committee set up by the Electricity Commissioners as a result of painful experience worked energetically at the problem, and we are deeply indebted to this committee for its clarification of the problem and for the resultant proper provision for protection against fire.

It may be assumed from the published recommendations of the Commission that, so far as cables are concerned, the main problems to be faced arise from extraneous fires mainly due to flowing burning oil in a station or a substation. The recommendations of the Commissioners were made after full consultation with the industry, and with them the cable-makers are in full agreement.

It may be useful to discuss the manner of giving effect to these recommendations, and the effect that the protection may have on the performance of the cables under normal operating conditions. The essential requirement for the fireproofing of lead-sheathed paper-impregnated cables is that the fireproofing should be sufficiently heat-resisting fully to protect the cable, of sufficiently low thermal conductivity so as not to decrease unduly the current rating of the cable, and that either its composition is such that it does not set up corrosion of the lead sheath or, alternatively, that it is provided with protection against such corrosion.

A combination of all these properties was not easy to find, and a good deal of investigation was required before the best materials were found. Also in some cases the use of the best method was not possible on systems already installed, and alternative methods had to be sought. Dealing with the question of cables emerging from the floor and going upwards to connect to switchgear, etc., or to other cables run in the vicinity of such gear, etc., the method selected for new installations and for existing installations where space was available was to use moulded asbestos supplied by the makers in the form of split-tubes which could be clamped around the exposed length of the cable. Apart from the ease of fitting and the comparatively pleasing finish of the work, this material represents the nearest approach to the ideal characteristics mentioned above. Magnesia has probably a higher degree of resistance to fire than the asbestos mouldings, but the thermal resistivity of the material is so high that the current rating of the cable would be greatly diminished.

The thermal resistivity of moulded asbestos is of the order of 700 thermal ohms, a value which with the thickness of material used would normally decrease the current rating of the cables by about 20 per cent. Against this, however, may be offset the normal increase of rating due to the fact that the cables to the ground are probably grouped, whereas when they are taken to switchgear they are separated apart a distance sufficient to free them from 'proximity heating'. This generalization, however, must not be carried too far, since if the cables in the run are separated throughout and operated at or near their maximum current, the asbestos-covered section would reduce the permissible current to an extent which would require serious consideration.

The fire-resisting properties of the moulded asbestos material appear to be extremely good. From figures quoted by the makers, the white asbestos material only begins to suffer damage when subjected to a temperature of 2,500° F., and the asbestos compound can withstand much higher temperatures for short periods. Tests carried out by the E.R.A. on cables protected by moulded asbestos exposed to a serious oil fire showed that, while parts of the burning enclosure reached a temperature of about 1,100° F., the highest recorded temperature on the protected cable sheath was 176° F. More severe tests of the same material used as a protective covering for steel girders showed that after a period of more than four hours exposure, during which the ambient temperature rose to 2,100° F., the temperature of the protected ironwork was only 850° F. It should be noted that the material is somewhat alkaline and that, to ensure protection against corrosion, the lead sheath of the cable should first be protected with a layer of bitumen paint and wrapped with one layer of bituminized tape.

For existing installations in which the conditions of erection are such as not to allow the use of moulded asbestos, a very good degree of fire resistance can be ensured by stripping off all the existing protective wrappings to the armour (or lead as the case may be), painting the cable with bitumen paint, wrapping with a layer of bituminized tape and then applying two layers of asbestos tape with a sensible overlap. The asbestos should be freely painted with silica paint.

For a number of years the research staffs of the associated firms of cable makers have been attempting to produce fire-resisting or self-extinguishing rubber compounds, and a fair degree of success has been obtained in imparting these properties to rubber. The fundamental difficulty has been that raw rubber is not self-extinguishing when once ignited, and the other materials which it is necessary to incorporate in the 'mix' to overcome the lack of self-extinguishing properties greatly modify its other desirable properties.

A new synthetic material has been discovered which belongs to the same general chemical group as rubber. This material in its raw state is very similar in its physical properties to raw rubber. It is converted into a suitable 'mix'. As, however, the material is fire-resisting, it is not necessary to obtain the fire resistance at the expense of other properties. Extensive tests have shown that this synthetic material is more resistant than rubber to deleterious influences.

Fires which have occurred in coal mines during recent years with deplorable loss of life raised the question in some minds as to how far electrical cables have been responsible for either initiating a fire or conveying an existing fire from one part of a mine to another. At the instigation of Mr. Horsley, electrical inspector of mines, the cable makers agreed to carry out experiments with the view of obtaining data which would answer certain specific questions. It was found that the application of a hot external flame for about 15 seconds was necessary to ignite the compound on the wrappings of a standard C.M.A. cable ; hence it does not seem probable that such wrappings around the cable would be ignited as the result of a transient flame such as would arise, for example, from an explosion of fire damp. The experiments also showed that the armour wires practically completely protected the inside of the cable. The cable makers have to be congratulated on the way they have co-operated in very expensive researches for their mutual benefit.

NEW INTERNATIONAL COMMISSION OF SNOW AND GLACIERS

BY F. E. MATTHES

AT the Seventh Assembly of the International Union of Geodesy and Geophysics, which was held in Washington last September, the International Association of Scientific Hydrology, one of the component units of the Union, effected the consolidation of two of its own commissions—the Commission of Snow and the Commission of Glaciers. The action was taken after a preliminary poll of the membership of the two commissions had shown an overwhelming majority in favour of the consolidation. Moreover, the presidents of both commissions, Prof. J. E. Church, of the University of Nevada, U.S.A. (snow), and Mr. J. M. Wordie, of St. John's College, Cambridge, Britain (glaciers), had strongly recommended it.

Prof. Church was designated acting president of the new Commission of Snow and Glaciers, to serve in that capacity until international relations will permit the holding of a formal election of officers. Like all other sections of the International Union of Geodesy and Geophysics, the Association of Hydrology has deferred election of officers for the present triennial period, in view of the sparse attendance of European delegates at the Washington assembly, due to war conditions.

The new Commission of Snow and Glaciers aims at taking into its purview all research relating to snow and ice in their varied forms. It might appropriately have been named Commission of Snow and Ice, but it preferred to adopt the name Commission of Snow and Glaciers in deference to the former Commission of Glaciers, which is by far the older of the two bodies that are now consolidated, and which, indeed, was in existence long before the Association of Hydrology was formed.

The original Commission Internationale des Glaciers had its inception in 1894, at the International Geological Congress at Zurich. It was charged, broadly, with the task of studying existing glaciers throughout the world ; but actually its efforts have been concentrated on securing statistics of the secular variations—advance and recession—of glaciers in response to climatic fluctuations. Inasmuch as this task requires the making of annual measurements on large numbers of glaciers in different countries, with the aid of co-operating agencies, governmental, scientific, and other, it has inevitably grown into a vast enterprise. The results, however, have proved of value, not only to glaciologists but also to hydrologists, hydraulic engineers (making use of run-off from glaciers for economic purposes), and climatologists.

In 1914 the work of the Commission was stopped by the war, and co-ordinated effort ceased for a number of years. In 1927, however, at the invitation of the International Association of Scientific Hydrology, the Commission transferred its functions and its personnel to a new Commission Glaciologique created by the Association, and under these new auspices its work has been carried on ever since.

Meanwhile, at the Lisbon assembly, in 1933, the Association set up a Commission of Snow and appointed Prof. Church president of it. So rapidly did this Commission grow under the enthusiastic leadership of its president that by 1936, when the Association met in Edinburgh, it had become by far the largest and most active of all the commissions of the Association and had extended its field to cover all phenomena of snow and ice, with the exception of glacier variations. Overlap with the work of the Commission of Glaciers seemed almost inevitable, and so the question naturally arose whether consolidation of the two commissions would not in the end be mutually advantageous to them. Their union was approved by the Executive Committee of the Association at its meeting in April 1939 at Montreux, Switzerland, and so the way was paved for its final consummation at the Washington assembly.

Provision has been made within the new Commission of Snow and Glaciers for a permanent Committee on Glacier Measurements, which will continue the work previously carried on by the Commission of Glaciers, securing systematic records of the annual variations of glaciers. It is Prof. Church's intention to expand the scope of that work, which heretofore was restricted largely to Europe and the United States, so as to take in all of the more important glacier districts of the world, including the Andes of South America, the great mountain chains of Asia, the Alps of New Zealand, and the Arctic regions.

Aside from this enterprise the Commission has planned for the triennium ending in 1942 the following formal programme:

(1) Study of the origin, drift, and dissolution of icebergs, with reference to the forecasting of their seasonal appearance.

(2) Physical changes in the snow-cover conducive to run-off, especially floods.

(3) Study of the crystalline texture of glacier-ice in relation to the mode of movement of glaciers.

In addition, the following four special projects have been assigned to temporary committees:

(*a*) Standardization of maps of snow-cover and ice-cover for the world.

(*b*) Uniform classification of different types of snow and snow-cover, and uniform nomenclature for the same.

(*c*) A system of classification for the international bibliography of snow and ice.

(*d*) Standardization of methods of snow-surveying and forecasting run-off from snow.

TRAINING INDUSTRIAL WORKERS

IN *Occupational Psychology* (14, No. 1), B. Ungerson discusses the important problem of the training of industrial workers. In spite of the improvement in methods of training learners during recent years, there are still numerous organizations where the only method of training is to let the beginner copy an experienced worker, or he is told what to do and left to get on as best he may.

The resulting efficiency frequently falls short of what he might have attained. It is strange that while it is recognized that games are best learned under the tuition and guidance of an experienced teacher, industrial processes are so frequently allowed to be 'picked up'.

Ungerson divides industrial training into two sections: (1) acquiring knowledge about the job; (2) acquiring facility and speed in making the necessary movements.

The first includes knowledge of technical terms, the tools to use, how to deal with unusual circumstances; such knowledge can best be taught by a skilled teacher—not necessarily equivalent to the most skilled worker—whose primary business is teaching, not production, and who shall have the requisite qualities for teaching and be given adequate facilities.

In order to teach the correct movements the teacher should himself have a conscious knowledge of them, and for this, motion study is essential. By motion study knowledge is gained of the adequate and useless movements, so that the learner is instructed from the beginning in the right method, and thereby saved from having to unlearn unnecessary movements later.

The principles of motion study which are based on the physiology and psychology of habit formation are no longer a problem for research; it is their application that is needed.

The article is very well balanced and constructively critical, and is of immediate importance.

'SPIKE' DISEASE OF SANDAL

FOR many years after it was first reported in 1898 the so-called 'spike' disease of the sandal tree remained an enigma. Investigations were carried out in a desultory fashion, but no information of value resulted. It is only owing to its alarmingly rapid spread in many parts of the Madras Presidency and elsewhere in Mysore and Coorg that the work of the last few years has resulted in methods of control, the results of careful research work, being successfully elaborated and put into force.

In *Indian Forest Records* (New Series. Silviculture, 3, No. 7; 1939) appears a paper entitled "A Note on the Control and Eradication of New Outbreaks of the Spike Disease of Sandal (*Santalum album*)" by Rao Sahib S. Rangaswami and A. L. Griffith, Sylviculturist, Madras. The sandal, as is well known, is a root parasite which lives by haustorizing on the roots of other plants which act as hosts to it. These hosts may be many and varied, for the same sandal tree and the sandal haustoria may wander a considerable distance before a suitable host is found. The sandal tree is not necessarily parasitic on the plants growing nearest to it.

The action of the disease causes both new shoots and leaves to stand up stiff and bristle-like, from which the popular name was derived. The disease itself is a virus disease carried by insects which are probably between 1/20 in. and ¼ in. in size. In a diseased area the sources of infection are (*a*) diseased trees, (*b*) disease masking trees, and (*c*) insect vectors.

Factor (*a*) is removed by poisoning the diseased trees with 'Atlas Tree Killer' solution and thus killing them at once; factor (*b*) by tapping all the apparently healthy trees found in the diseased locality, and girdling and treating with poison all those that afterwards show the disease; and factor (*c*) is eliminated automatically, or the removal of the factors (*a*) and (*b*) naturally converts the viruliferous insects into non-viruliferous ones.

As indicating the rapidity of spread of this disease, in the North Salem Forest Division alone 'spike' first appeared in 1913. Twenty years later the infected area was 54,000 acres and in 1938 approximately 99,500 acres. Figures so far available indicate that the annual amounts spent on this research work have been but a fraction of the annual losses inflicted by the disease and of the sums saved. It is a classic example, as the authors say, "that 'academic' research can often be utilized by a practical forest department at a reasonably low additional expenditure to produce 'practical' results of immediate financial value". For quite contrary reasons the attention of the Governments of Burma and Nigeria may be directed to this valuable paper.

LYMPHATIC SYSTEM OF THE ANURA

A CONSIDERABLE amount of work on the lymphatic system of the lower vertebrates has been published in recent years. A recent treatise (*Amer. Anat. Mem.*, No. 18; 1939) is a survey of that work as it affects the Anura in particular. It is not simply a review of the literature, although this is fully taken into account and critically examined, but is also a description of the development of the lymph- and their relation to the blood-vessels, based upon hundreds of injections (both single and double) of five species of frogs, five species of urodeles, and two species of fish.

Dr. H. M. Knower, the author, first started investigating this problem in 1903, and in 1908 described a microinjector which has proved of considerable value in this rather difficult subject. The work is illustrated by forty excellent drawings on nineteen plates and five text-figures. The drawings are all of preparations of *Rana palustris*, save five which are of *R. catesbiana*. It is claimed that the method of injection, if carefully checked, provides a more satisfactory approach than the study of transverse sections of uninjected material, and with this most zoologists who have tried tracing these elusive vessels in sections will agree.

The first lymphatics appear when a complete blood circulatory system has been established, and are accessory or supplemental to the veins. They appear in connexion with the pronephric glands and the adjacent segmental glands, and this dorso-lateral plexus, in which the anterior lymph heart develops, drains into the pronephric sinus by a short vein. From this stage the development of the system is followed until the establishment of the definitive condition of the late tadpole. It is a pity that the zoological practice of putting specific names in italics has not been followed and that on p. 23, for example, *R. nig.* appears presumably for *R. nigromaculata*, and that throughout the name toad is used again presumably for some species of Bufo.

SEVENTY YEARS AGO

NATURE, vol. 2, May 12, 1870

A Building for the Learned Societies

THE Statistical Society has done good service to the cause of science in convening representatives of the learned societies, to consider whether it would not be possible to obtain a building for their accommodation worthy of the high position they occupy in this great metropolis. "Some of the societies have no reason to complain, the Royal Society, the Linnean, the Royal Astronomical, the Geological, the Chemical, the Society of Antiquaries, and a few others, are well accommodated, and a solid structure is being raised for them in Piccadilly."

The article goes on to point out that financial objections might be raised to a scheme for a new home for learned societies. To this the reply is that the Government should provide one or more buildings for the purpose. "Nowhere does the State do so little for science as in this country. The estimates for 1870–71 give the entire sum to be applied to the learned societies at 2,370 *l*—a sum distributed among very few of them. . . . In addition to this 160,000 *l* are appropriated to a building for certain learned societies in Burlington House; but it will serve for very few of them; and if we are rightly informed, the Government will reoccupy all the buildings in Somerset House now used by learned societies."

In the event that the Government refused to provide funds for a suitable building, the formation is suggested of a joint-stock company, the shares in which would be taken up by the members of the societies interested. "It has been estimated that the probable cost of a building sufficiently commodious, though not ornamental, in some eligible locality near Charing Cross, will be, with the ground-rent, 30,000 *l*. to 40,000 *l*."

Strange Noises heard at Sea off Grey Town

MR. CHARLES DENNEHY, of the R.M.S. *Shannon*, describes a peculiar noise heard on board iron vessels anchored off Grey Town, at the mouth of the River St. Juan, which separates Nicaragua from Costa Rica. Vessels are obliged to anchor in seven to eight fathoms of water outside the bar, and crews are regularly awakened at night by "a peculiar metallic vibratory sound". This noise, which commences "with a marvellous punctuality at about midnight", continues for about two hours with one or two very short intervals. The noise is not heard on shore, or on coppered wooden vessels. The bottom consists of a heavy dark sand and mud containing much vegetable matter brought down by the river. "The ship is undoubtedly one of the principal instruments in its production. She is in fact for the time being converted into a great musical sounding board."

The letter is followed by the brief comment: "Our correspondent should dredge.—Ed."

REFERENCE is made to the fact that a considerable number of papers are on hand at the Royal Society, and only two more meetings have been arranged for the session. Were not the present arrangements of the Royal Society meetings made to meet conditions long since passed away? And since the flow of papers into the Society has largely increased, why should not the outflow be a little accelerated?

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, May 14

Royal Sanitary Institute, at 5 p.m.—Lieut.-Colonel J. A. Dixon: "Centralized Slaughtering" (Benjamin Ward Richardson Lecture).

Royal Institution, at 5.15 p.m.—Sir Frederick Keeble, F.R.S.: "The Development of the Home Production of Food".*

Thursday, May 16

Royal College of Surgeons of England, at 4 p.m.—Prof. A. D. Macdonald: "Experimental Spinal Anæsthesia".

Chemical Society (at the Institution of Mechanical Engineers), at 6 p.m.—Prof. W. N. Haworth, F.R.S.: "Recent Developments in the Chemistry of Carbohydrates" (Seventh Pedler Lecture).

Friday, May 17

Faraday Society (at the Royal School of Mines), at 2.30 p.m.—General Discussion on "The Hydrogen Bond".

(Speakers—Dr. W. T. Astbury, F.R.S.: "The Hydrogen Bond in Protein Structure"; Dr. C. E. H. Bawn, Prof. E. L. Hirst, F.R.S., and Dr. G. T. Young: "The Nature of the Bonds in Starch"; Dr. J. J. Fox and Dr. A. E. Martin: "Infra-Red Absorption of Hydroxyl Group in Relation to Inter- and Intramolecular Hydrogen Bonds"; Dr. J. M. Robertson: "X-Ray Evidence for the Hydrogen Bond"; Dr. G. B. B. M. Sutherland: "The Investigation of Hydrogen Bonds by Means of Infra-Red Spectra").

Royal Institution, at 9 p.m.—Prof. D. R. Hartree, F.R.S.: "A Great Calculating Machine; the Bush Differential Analyser and its Applications in Science and Industry."

Association of Teachers in Technical Institutions (Thirty-first Annual Conference, at the Hotel Russell, Russell Square, London), May 11–12.

May 12, at 10 a.m.—S. H. Moorfield: Presidential Address.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant in the Bacteriology Laboratory at Wray Castle—The Director, Freshwater Biological Association, Wray Castle, Ambleside, Westmorland (May 14).

Part-time Educational Psychologist—The Director of Education, Education Offices, 15 John Street, Sunderland (May 15).

Lecturer in Electrical Engineering Subjects at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (May 16).

Director of Education and Inspector of Schools in the County Borough of Barnsley—The Director of Education, Education Department, Town Hall, Barnsley (May 17).

Construction Engineer for the Irrigation Department, Government of Ceylon—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9322) (May 17).

Demonstrators (Male) in the Department of Anatomy—The Secretary, King's College, Strand, W.C.2 (May 23).

Teacher for Colombo-British Institute, Bogota—The British Council, 3 Hanover Street, W.1 (quoting 'Colombia') (May 25).

Lecturer in Civil Engineering—The Registrar, King's College, Newcastle-upon-Tyne (May 31).

Lecturer in Plant Pathology and Zoology—The Principal, Swanley Horticultural College for Women, Swanley, Kent (May 31).

Assistant in the Department of Education—The Secretary, Queen's University, Belfast.

Technical Officers—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting Ref. A.500).

Assistants I (Ref. A.501), Assistants II (Ref. A.502), and Assistants III (Ref. A.503)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. (quoting appropriate Ref. number).

Assistant Engineer for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge during the Academical Year 1938–1939. (Published by Authority.) Pp. 162. (Cambridge: Printed at the University Press.) [94

Reports of the Progress of Applied Chemistry. (Issued by the Society of Chemical Industry.) Vol. 24, 1939. Pp. 756. (London: Society of Chemical Industry.) [94

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 22: The Requirements of the Pig for Vitamins A and D. By Brendan J. Senior. Pp. 229–236+plate 6. 1*s*. Vol. 22 (N.S.), No. 23: The Chemical Constituents of the Lichen *Parmelia latissima* Fée. Dr. T. J. Nolan, Dr. J. Keane and V. E. Davidson. Pp. 237–240. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [94

Publications of the International Tin Research and Development Council. No. 96: The Determination of Tellurium in Tin-Rich Alloys. By Dr. W. T. Pell-Walpole. Pp. 4. (Greenford: International Tin Research and Development Council.) Free. [104

Imperial Forestry Institute: University of Oxford. Fifteenth Annual Report, 1938–39. Pp. 38. (Oxford: Imperial Forestry Institute.) [104

Other Countries

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 780: Geology and Ground-Water Hydrology of the Mokelumne Area, California. By A. M. Piper, H. S. Gale, H. E. Thomas and T. W. Robinson. Pp. vii+230+22 plates. 2.25 dollars. Water-Supply Paper 821: Surface Water Supply of the United States, 1937. Part 1: North Atlantic Slope Basins. Pp. viii+441+1 plate. 50 cents. Water-Supply Paper 850: Summary of Records of Surface Waters, 1898–1937. By C. E. Ellsworth. Pp. vi+154. 20 cents. (Washington, D.C.: Government Printing Office.) [84

South Australia. Annual Report of the Director of Mines and Government Geologist for 1938. Pp. 8. (Adelaide: Government Printer.) [84

University of Illinois: Engineering Experiment Station. Bulletin No. 318: Investigation of Oil-Fired Forced-Air Furnace Systems in the Research Residence. By Prof. Alonzo P. Kratz and Prof. Seichi Konzo. Pp. 88. 90 cents. Bulletin No. 319: Laminar Flow of Sludges in Pipes with Special Reference to Sewage Sludge. By Prof. Harold E. Babbitt and David H. Caldwell. Pp. 58. 70 cents. Bulletin No. 320: The Hardenability of Carburizing Steels. By Prof. Walter H. Bruckner. Pp. 62. 70 cents. Circular No. 40: German-English Glossary for Civil Engineering. By Alphonse A. Brielmaier. Pp. 38. 45 cents. (Urbana, Ill.: University of Illinois Engineering Experiment Station.) [84

Annuaire de l'Académie Royale de Belgique, 1940. (Cent-sixième année.) Pp. 170+45+2 plates. (Bruxelles: Académie Royale de Belgique.) [84

Publications of the Dominion Astrophysical Observatory. Vol. 7 No. 9: The Mass Ratio of the Lithium Isotopes from the Red Bands of Li_2. By Andrew McKellar and F. A. Jenkins. Pp. 155–188. (Victoria, B.C.: Dominion Astrophysical Observatory.) [84

Memoirs of the India Meteorological Department. Vol. 27, Part 1: A Study of the Duststorms of Agra. By B. N. Sreenivasaiah and N. K. Sur. Pp. 30+10 plates. (Delhi: Manager of Publications.) 1.12 rupees; 2*s*. 6*d*. [84

Ministry of Public Health, Egypt: The Research Institute and the Endemic Diseases Hospital. Sixth Annual Report, 1936. Pp. vii+63+12 plates. (Cairo: Government Press.) [84

The Engineering Foundation. Twenty-five Years of Service, 1914–1939. Pp. 86. (New York: The Engineering Foundation.) [84

Department of Science and Agriculture, Jamaica. Bulletin No. 18: Reprints of Miscellaneous Articles, 1937. Pp. 56. 6*d*. Bulletin No. 20: Field Experiments on Sugar Cane in Jamaica, 1936–39. Report by H. H. Croucher and M. S. Goodman. Pp. 20. 6*d*. Bulletin No. 21: Forestry and Erosion in Haiti and Puerto Rico. By C. Swabey. Pp. 12+9 plates. 6*d*. (Kingston: Government Printing Office.) [84

Indian Forest Records (New Series). Silviculture, Vol. 4, No. 2: An Investigation into the Relative Merits and Costs of Five Different Weeding Methods in the Formation of Teak (*Tectona grandis*) Plantations in areas having a West Coast Type of Climate. By A. L. Griffith. Pp. v+97–132+2 plates. (Delhi: Manager of Publications.) 1.10 rupees; 2*s*. 6*d*. [114

Catalogues

Annotated Catalogue of Works on Exact Science. (Sotheran's Price Current of Literature, No. 864.) Pp. 160. (London: Henry Sotheran, Ltd.)

Books, Prints and Autographs on the Theatre, including the Circus Pantomimes, Exhibitions, Showmanship and Pleasure Gardens (Catalogue No. 648.) Pp. 46. (London: Francis Edwards, Ltd.)

Bromethol B.D.H.: a British Basal Anæsthetic for use by Rectal Injection. Pp. 2. (London: The British Drug Houses, Ltd.)

Diet, Nutrition and Therapeutics. Pp. 12+2 plates. (London Vitamins, Ltd.)

"Technico" Laboratory Protective Paints, etc. (Publication No 362.) Pp. 4. (London: A. Gallenkamp and Co., Ltd.)

Kodak D-19b X-Ray Developer. Pp. 4. (London: Kodak, Ltd.)

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CULTURAL RELATIONS OF FRANCE AND BRITAIN

THE cause for which NATURE stands, the disinterested pursuit of scientific inquiry, cannot recognize distinction of race, creed, language or nationality. Wherever the truly scientific spirit is at work, labourers in the intellectual field recognize one another as men and brethren ; and this is still the case, even in the distracted times in which we live. But here a tragic picture presents itself. What we have called the truly scientific spirit is wholly or partly quenched as soon as the lamp of freedom is extinguished. Freedom of thought and expression had been gained at a great price, and after centuries of persecution, in the chief civilized countries of the world. It has been temporarily lost in certain of the traditional and most influential homes of scientific and philosophic culture. In the words of M. Edouard Herriot, the dictators have killed in their countries the spirit of freedom and the idea of human dignity.

It falls, therefore, to the great democratic nations to uphold the banner of freedom. If they are to do so effectively, it must be through a deeper mutual understanding ; and in the long run such a result is really a question of education. It is essentially for that reason that steps have recently been taken by the responsible Ministries in Great Britain and in France to promote a sympathetic understanding of each other's aims and ideals in all educational institutions, and among all branches of the teaching profession, primary, secondary and university. In Great Britain it becomes one of our definite purposes to try to comprehend and appreciate the cultural position of our great ally.

At the close of the War of 1914–18, the general educational position in France closely resembled the position in Great Britain at the beginning of the century. After our Act of 1902, elementary schools no longer formed a water-tight compartment, having no connexion with secondary schools. But similar conditions remained unchallenged in France another dozen years or more. A French child of six entered either the local elementary school or the preparatory department of the *lycée*. The former was free, but the latter was not, and so at the age of six the educational destiny of the child was fixed, and depended upon the ability of his parents to pay fees. The vast majority of the children of France passed through the elementary schools until the age of thirteen, a small proportion remained for advanced courses, and a very few obtained scholarships at the *lycée* at the age of twelve. The barrier of class and wealth divided the elementary and secondary systems. The fortunate children (about one in ten) who entered preparatory departments at six proceeded at ten or eleven to the *lycée* proper, and at about seventeen took the *baccelauréat*, which gave access to the universities and other places of higher education. The *lycées* provided courses in classics, modern studies, and pure science, and were not vocational in any sense. Elementary and secondary teachers knew as little of each other as if they inhabited different countries. A queer sort of democracy, the reader may say ; however, like our own, it was and it is a democracy with a past.

But a profound educational stir took place during the last War and it is said that the idea of the far-reaching reform known as *l'école unique* was conceived by a group of officers in the trenches on the Western Front in 1917–18. Equal opportunities for all children, without regard to the means of their parents, was the fundamental feature of the reformers' demands. Sympathy and support came from many influential quarters, but long-established traditions die hard, and root-and-branch reform could not come quickly. For some years after the conclusion of the War the discussion was vigorously continued, and in 1927 a definite scheme was published, taking the form of a parliamentary Bill. It was this scheme which substantially became the law of the land in 1937, when M. Jean Zay was Minister for Education in the Popular Front Government.

The details of the new law, the operation of which is inevitably slowed down by the outbreak of the present War, can here be only briefly summarized. Similar courses of instruction are provided in all schools for children between six and twelve. At the latter age, tests are applied which determine whether a child continues his primary course to a higher stage or starts upon a secondary course. In the latter event he enters the *classe d'orientation* for a year, during which the kind of further education for which he is best fitted is settled. This *classe d'orientation* is from the point of view of British teachers the most remarkable feature of the system, and its working will no doubt be carefully watched, now that opportunities of exchange of duties with French teachers are being increased. In France itself the innovation has been subjected to adverse criticism, but the experiment is being very carefully conducted. This introductory year having been completed, the pupil enters upon a course either in classical or in modern or in technical humanities, the differences between the three being gradually made by increasing emphasis in one of the three directions. The gradual abolition of fees in the case of students who reach scholarship standard brings within sight in France what Mr. Harold Nicolson, M.P., in a recent broadcast talk, has advocated for England—a classless education.

From the point of view of NATURE, perhaps the most interesting and important thing yet remains to be said. Throughout his course, it will be observed, the pupil is engaged upon the humanities, with gradually increasing stress upon the classical or modern or technical side—but always the humanities. In Anglo-Saxon countries, specialization may be carried so far that from a too early age a boy devotes himself so much to what may be found inside a laboratory that, unless his home opportunities are uncommonly good, he may develop into something which one hesitates to call an educated man. From that position the French tradition of general culture is a safeguard. The more one studies the history of educational changes and controversies in France, the more deeply impressed one becomes by the steadfast adherence of the French mind to that tradition. For three centuries, including the Revolution, the Napoleonic era and the Restoration, the old classical tradition remained intact, partly to secure secondary education as a privilege for the upper and middle classes, but partly also because nothing satisfactory was found to take its place. A change was bound to come, as Matthew Arnold foresaw in 1865, but it came slowly. The legacy left by the classical tradition is seen in the continued determination that French culture, which led the way in Europe for centuries, shall be preserved. To quote Prof. Kandel, an American authority on comparative education, it is through "*études désintéressées*" (general studies), that French secondary education "aims to cultivate judgment, taste, appreciation, and an ability to think clearly and logically. . . . More concretely expressed, the measure of a sound liberal education is the ability to speak well and to write well, as the outward indication of clear thinking".

More recently, Prof. Kandel has, in his capacity as editor of the 1939 report of the International Institute, Teachers College, Columbia University, brought together two statements by distinguished Frenchmen on the meaning of a liberal education in France in the twentieth century. One of these authorities, the Director of the École Normale Supérieure, though making concessions to the modernists, ends by declaring that the advocates of a liberal education based on a general classical culture, if they must yield any territory, will put up a fierce resistance, relying on a tradition of which France is proud. The other, a professor at the Lycée de Versailles, and general secretary of Les Compagnons de l'Université Nouvelle, equally maintains that a liberal education should subordinate the acquisition of knowledge to the task of so educating the mind as to enable it to attain to as broad and deep a culture as possible. But he denounces the exclusively literary tradition as exhibiting a blind faith in a single ideal supposed to lie beyond discussion. He charges the advocates of that tradition with showing profound ignorance of the vast extensions of the human spirit as a result of the development of experimental sciences since the sixteenth century, and with slighting "the remarkable educative value of the use of the experimental methods for intellectual training". We think the flowing tide is with the modernists.

There, however, we must leave the matter, trusting to have said enough to suggest the immense importance of supplementing the defensive and economic relations of Great Britain and France by a better understanding than ever before of the educational aims and aspirations of the two countries. As M. Sarraut has recently said to the educational leaders of France, the spirit of sympathy and cordiality for the people of the Allied countries must be created among all young people from school children to university students. There can, he wisely added, be no question of exercising any pressure in influencing their minds. Neither familiarity nor affection can be imposed. But we can prepare the ground which favours their development, and this is less perhaps a matter of direct teaching than of providing opportunities of bringing about an intuitive understanding.

A GREAT PSYCHOLOGIST OF SEX

My Life
By Havelock Ellis. Pp. xviii + 542 + 8 plates. (London and Toronto: William Heinemann, Ltd., 1940.) 15*s*. net.

HERE we have the life-story of one who, with many other literary and cultural achievements to his credit, will be known above all as the man who made it his chief work to bring sanity into the sphere of sex and to remove those taboos which had hitherto kept sex so largely outside the pale of impartial scientific thought. This autobiography is no mere product of the author's declining days; it is the fulfilment of a project formed in early life, a project that, like all his other enterprises, came slowly but steadily to fruition, being written at what he judged to be the most favourable moments from the age of forty onwards. Ellis indeed held autobiography in high esteem; it was his view that "of all forms of prose, outside the limits of imaginative art, there is no other form so precious in its nature and so permanent in its value". There can be little doubt that the book does well and truly fulfil its author's purpose. Although it is unlikely that it will ever be considered one of the world's very few imperishable monuments of self revelation, it yet provides a sympathetic and illuminating picture of a delicate, sensitive and philosophic being, who was willing to accept himself with the capacities and limitations that Nature had provided, and who understood well how to reconcile himself to his limitations and to make the most of his capacities—a task that few accomplish with so good a grace and in such ample measure.

More than half of the book is concerned with the years of his marriage, and this provides a fascinating study of the long union of two very dissimilar personalities—the retiring, methodical, introvert Havelock, and the gifted but tempestuous extravert Edith (née Lees) who was his wife—a union further complicated by the existence of a strong homosexual tendency in the latter partner, though at the same time one that was firmly cemented by a deep personal affection and a lively common concern for the welfare and progress of humanity. With the death of Mrs. Ellis in 1916 (after an illness that affected both her mental and her physical health) the detailed story ends, and but a few pages are devoted to the remaining twenty-three years of his life. His marriage ended and his major self-appointed task accomplished (the last of the six original volumes of the "Studies in the Psychology of Sex" was completed in 1910, though a supplementary seventh volume appeared in 1928), he felt he had drunk deeply of the well of life and could afford to enjoy in relative tranquillity such years as yet remained. These years, filled with loving companionship, with tender memories, and with the sense of a task well accomplished and in its outcome successful beyond all expectation, were very happy ones, and the book ends on a note of optimism that nowadays is rarely to be met with. In an age in which we are beginning to look back with nostalgic longing to the calm days of the later nineteenth century, it is cheering and refreshing to realize that, in the eyes of one who lived and strove in those days, our modern world, for all its insecurity and manifest disorder, holds many compensations—compensations which to Ellis were the greater in as much as he felt that he himself had contributed to their existence.

Many readers will regret that the book does not deal more fully with the author's intellectual development and the emotional factors underlying it. We are, it is true, told how, as a young man of about twenty, he had already dimly formed the project which afterwards found fulfilment in his *magnum opus*. Looking back some fifty years he recognized that "here had come a youth whose impulse it was to intellectualize and moralize his own personal situation, thereby transferring it into an impersonal form and universalising it"; but we learn all too little as to how his thought developed as the work progressed. We know of the paramount importance of the writings of James Hinton for his early years, but we are told almost nothing about his reactions to the great movements, events and figures of his own time; there is no mention, for example, of his great contemporary Freud, whose work lay so largely in the same field as that of Ellis himself. For more enlightenment in these directions, we would perhaps willingly have sacrificed some of the rather speculative reflections on hereditary influences that fill a good many of the early pages and some of the letters to and from his wife that are found in such abundance in the later chapters. But an autobiographer has clearly the right to say what seems to him of chief importance, and, taken all in all, this book constitutes a worthy monument to a noble and prolific life.

J. C. FLUGEL.

ATMOSPHERIC AND TERRESTRIAL PHYSICS

Physik der Atmosphäre

Herausgegeben von V. Conrad. Bearbeitet von J. Zenneck, Rudolf Steinmaurer, P. Gruner, H. Landsberg, F. W. Paul Götz. (Ergebnisse der kosmischen Physik, Band 3.) Pp. xi + 333. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 32 gold marks.

Gerland's Beiträge zur Geophysik, Supplementband 4

Ergebnisse der kosmischen Physik, Band 4: Physik der Hydro- und Lithosphäre. Herausgegeben von V. Conrad. Pp. x + 293. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 31 gold marks.

IN 1931 appeared the first volume of the series "Ergebnisse der kosmischen Physik mit Einschluss der Geophysik", being a supplementary volume to Gerland's "Beiträge zur Geophysik". It contained a series of excellent articles, on the aurora, cosmic rays, ozone, sound propagation, the earth's figure, and wave-motions. A second volume appeared in 1934, containing articles on glaciers, atmospheric ionization, gravity, seismology, cosmic rays, and earth faults. These two volumes, edited by Conrad and Weickmann, were finely produced by the Leipzig Akademische Verlagsgesellschaft.

Two new volumes have since appeared, produced in the same fine style as before, under the sole editorship of Conrad, now in the United States, a refugee from Austria. The price-level remains at the high figure which practically precludes most readers from possessing copies of their own, and forces them to resort to library copies (perhaps consoled by the reflection that the contributors' remuneration was probably more generous than is usually accorded to those who perform this valuable public service of reporting on developing topical branches of science). The quality of the contributors and their work also preserves substantially the standard of the two previous volumes. A somewhat different plan of editing has been followed, however, in that volume 3 deals exclusively with atmospheric physics, and volume 4 with non-atmospheric subjects.

Volume 3 contains five articles; the first, written by Zenneck with much freshness and lucidity, is on the ionosphere (37 pp.), the second (75 pp.), by Steinmaurer, on cosmic ray studies during the years 1933–37, the third (42 pp.), by Gruner, on dawn phenomena, next a small treatise, by Landsberg, on condensation nuclei (98 pp.), and finally a continuation (73 pp.), by Götz, of his excellent article on ozone in volume 1. Each article contains its own bibliography, which in most cases ends with 1937 references; there is, for example, no reference to mesons and their instability, in connexion with the barometric effect on cosmic rays. There is an authors' index to the whole volume, but no subject index. Similar remarks apply to volume 4.

Volume 4 opens with a 74-page article by Ekman on convective streams in the oceans; the remaining articles deal with the physics of the solid earth. Jeffreys discusses deep-focus earthquakes (31 pp.), Tsuboi writes on crustal deformations as indicated by geodetic measurements (63 pp.), Gutenberg on the development of seismic prospecting methods (50 pp.), and the volume concludes with a somewhat curious article (71 pp.), by Fritsch, on "the structure and properties of geological conductors", dealing with their electrical resistivity, earth currents, and the underground reception of radio waves.

All the articles are written in German except three—those by Landsberg (volume 3) and by Jeffreys and Tsuboi (volume 4)—which are in English.

PHENOMENOLOGY OF LITERATURE

The Growth of Literature
By H. Munro Chadwick and N. Kershaw Chadwick. Vol. 3. Pp. xxvi + 928. (Cambridge: At the University Press, 1940.) 35*s.* net.

THIS bulky and well-printed volume concludes the ambitious enterprise of its authors to give a history, illustrated by abundant examples, of the origin and growth of literature from what they call the 'heroic' ages of various peoples down to the time when, owing to the general knowledge of reading and writing and the improved communications between different nations, compositions, whether intended to instruct or delight, take on the forms with which Europe has been familiar, at least in its more civilized regions, for the last couple of millennia. In short, the work deals largely with that literature which existed, and here and there continues to exist, without the aid of letters or with but a minimum of help from them.

Having examined the early European literatures in the first volume and those of India, the Hebrews and the Slavs in the second, the authors devote this third volume mostly to a survey of the 'oral' literatures of the Tatars, the Polynesians, with some twenty pages added to sketch that of the Ibans or Sea Dyaks, and a few African peoples. With that frankness and lack of pretence which is one of the best features of their work, they point out their own involuntary deficiencies, the causes of which range from the difficulty of procuring from Russian booksellers recent monographs on Tatar culture to the sheer non-existence of records of the doings of many African peoples, at least so far as their songs and stories are concerned. It has been indeed a defect of many collectors that, when getting together material from their chosen fields, they have paid attention too exclusively to folk-tales (not noticed in this work, as being in their nature international) and not sought as diligently as they might for beginnings of higher forms which might one day develop into epics or hymns, the products of courtly or priestly circles. But with these defects, and others which must needs arise in a treatise covering so many linguistic areas, the work is still a most valuable repository of well-commented information on its subject. It may claim to be the most complete account yet given of what may be styled the phenomenology or typology of literature, within the limits of study which the authors have set themselves.

It may, however, be questioned whether it is in any proper sense a history of early literature, or indeed whether such a history is possible for anyone, however learned, to produce in the present state of our knowledge. We are shown abundantly that the various types of composition examined (there is an elaborate classification, repeatedly explained, of the different *genres*) exist in sundry parts of the world. We are given several short specimens of each type from each area and good synopses of other works. Speculations are modestly put forward as to the conditions favourable to their growth and the kinds of society which produced them. Here and there (as on p. 409, which discusses the affinities of Polynesian and Japanese poetry) we are at least furnished with material for investigating a historical connexion between one area and another. The question of diffusion or polygenesis is fairly faced, more than once (as on pp. xxiii, 216–18, 495–6).

All these are necessary steps toward constructing a history of early literature, but not yet the history itself. It may be seriously doubted whether the most diligent student of the book could write an accurate sketch of the process by which, given a certain environment, this or that type might be expected to appear, the conditions under which it would naturally give place to another and the extent to which it will co-exist with a third. Indeed, since the subject is the doings of man, which are in the last resort unpredictable, it is reasonable to doubt whether such a feat will ever be possible. But, even with the help of the last two hundred odd pages of this volume, devoted to a "general survey" of the subject, it is scarcely true that the less ambitious task of showing how, in fact, the literary forms have hitherto come about has been completed.

This is not meant to be derogatory to the authors; it merely states that they have not achieved what the reviewer believes to be impossible. Some part of that task they have accomplished, and this is no small praise. They have shown, for example, that 'heroic' poetry, that of more or less epic type, is the offspring of what they call 'heroic' society, for example, that stage of barbarism in which the ruling class is warlike, predatory and as a rule illiterate. Its necessary subject-matter appears to be raids and wars waged at least partly with a view to plunder, with elementary tactics and strategy, giving much scope for the courage or cunning of the individual chieftain. It is, however, the fact that they have pressed this principle too far, and come out to some theories of the growth of the "Iliad" and "Odyssey" (see p. 770), which confuse the activities of the Ionian Homer, a man of comparatively high civilization, with those of the ruder minstrels who went before him. That is to say, they confound the early literary epic with the hero-ballad or the nascent epics to which it often gives rise. On p. 886, when the authorship of certain kinds of oral literature is referred (correctly, no doubt, for many countries) to a priestly class, it is forgotten that no such class existed in Greece. If this were a classical journal, some other inadequacies in this sphere might be pointed out; here it is enough to say that they are small and not very numerous, quite outweighed by the abundant light thrown on that and other areas.

In short, where the authors succeed, they deserve their success; where they seem to the reviewer to have failed, it is doubtful whether any amount of diligence or erudition would have done better.

H. J. ROSE.

BEHAVIOUR OF THE UTERUS

Physiology of the Uterus

With Clinical Correlations. By Prof. S. R. M. Reynolds. Pp. xx + 447. (London: Hamish Hamilton, Ltd., 1939.) 42*s.* net.

THE publication of a book entirely devoted to the behaviour of the uterus is an index of the remarkable advances that the last few years have seen in knowledge of reproductive physiology. Dr. Reynolds is a distinguished investigator of the problem of uterine motility, and while this topic is given great prominence, it cannot be said to be over-emphasized, and an excellent balance is maintained throughout the book between all aspects of uterine physiology.

The monograph opens with a brief account of the topography and anatomy of the Fallopian tubes and uterus, and with a description of the various patterns of contractility to which they are subject in the non-pregnant, pregnant, and parturient individual. The hormonal and other factors which control these patterns are then discussed, after which the author deals with the problem of uterine growth, laying particular emphasis on the nature of the growth which occurs in pregnancy, and on the factors responsible for it. The circulatory changes which take place in the uterus, their hormonal control, and their relation to the process of menstruation are reviewed in detail, and the problem of uterine metabolism is also dealt with. The book closes with a section devoted to the hormonal therapy of uterine disturbances.

The volume is a notable record of the scientific advances that have been made in the laboratory study of a subject which until recently has been the domain of clinical gynæcologists only. There can be little of value in the literature which has been overlooked by Dr. Reynolds, and his achievement may well serve as a stimulus and a model for further reviews of other fields of endocrinology and reproductive physiology.

AMERICAN NURSERY PRACTICE

Propagation of Horticultural Plants

By Guy W. Adriance and Prof. Fred R. Brison. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. ix+314. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20*s.*

THIS is a new American text-book dealing with the various methods employed in the multiplication of cultivated plants. After a short elementary introduction to the structure and function of plant organs, including the flower and its parts, chapters are devoted to 'layerage', 'cuttage', 'graftage', and other methods. Throughout, the text reads clearly; the descriptions are brief and direct. Modern methods are advocated, and the necessary equipment for carrying out the work is always described. However, the allocation of space is somewhat uneven; for example, the propagation of lilies, investigated and reported upon in America, is more fully dealt with in the text and by illustrations than that of hyacinths, studied by the Dutch, of which there is but brief mention and no illustration. Also the index contains no references to hyacinths. Root cuttings, leaf cuttings, and the propagation of ferns from spores are not dealt with.

Common names of American plants and diseases are frequently used. These may be unfamiliar to some English readers ; the legends to Fig. 105 and Fig. 106, to which no further reference in the text is made, read "A live oak top growing on a post oak rootstock" and "Upper part of this tree is live oak, top worked on to a post oak". In both illustrations posts are also shown, so that some confusion may arise, for every reader will not realize that *Quercus Virginiana* and *Q. stellata* are the plants concerned.

There is a useful chapter dealing with the relation of propagation practice to diseases. This could, with some advantage, be extended to include more pathology, for "Phony peach" conveys little, and the reader is not informed that it may be a virus disease. The grape root louse (Phylloxera) and woolly aphis are included in this chapter on 'diseases'.

There are selected short lists of references, most of which are to American publications, for the several chapters, but the questions at the end of each chapter are of doubtful value. The index would be improved by the inclusion of Latin names. As it briefly surveys a wide field, this will prove a useful book for students desirous of learning the outlines of American nursery methods.

M. A. H. T.

ANIMAL HORMONES

Hormones in Invertebrates
By Prof. Bertil Hanström. (Monographs on Animal Biology.) Pp. x + 198 + 13 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1939.) 12*s*. 6*d*. net.

OF recent years increasing attention has been paid to invertebrates to determine whether they provide evidence of chemical correlation similar to those hormonal reactions that are now recognized as being of tremendous physiological and philosophical importance in the life of man and other vertebrates. Even in 1933 the view was held by some workers that no clearly demonstrated incretory activity in invertebrates, nor any demonstrable influence of vertebrate hormones on invertebrates, had up to that time been found.

Since that time an ocean of endocrinological investigations has been charted, and here Prof. Bertil Hanström has found it useful to present in collated form a more or less complete summary of what is known at present about hormonal reactions in invertebrates. It is now realized that in invertebrates the presence of several incretory organs and many physiological processes cannot be explained without adopting the hypothesis of hormonal action. These investigations show that the previously accepted definition of a hormone as a substance which is secreted into the blood-stream by an endocrine organ, and which exerts a specific effect at another place in the body, is no longer tenable. The absence of blood in many invertebrates and the production of hormonal substances not in incretory glands but in portions of organs the chief function of which is quite other than hormonal, the hypotheses of 'gene hormones', 'growth hormones', 'wound hormones', 'organizers', etc., are evidence that a new hormonal concept should be adduced. In this work Hanström has accepted Köller's hypothesis of considering a hormone as an organic substance which is produced by the organism for its own use, and which has a specific regulatory function within it. As the author suggests, it is clear from the evidence already obtained, which is set out so lucidly in this monograph, that at least some invertebrate hormones may one day be used for important experimental and perhaps pharmacological purposes in vertebrates, including man.

The value of this book to endocrinologists no one would gainsay, but for the non-specialist it is lacking in appeal. In addition to presenting this comprehensive epitome of present-day knowledge, the author might have attempted to introduce a little hypothetical argument when discriminating between apparently diverse statements of fact. For this reason the book, which deals with a fascinating topic, loses a great deal of its attraction for the non-endocrinologist.

The literature index is comprehensive and up to date, but since a considerable portion of the book is given over to the discussion of the influence of vertebrate hormones on invertebrates, it is surprising that the author has omitted any reference to Szent-Györgyi's work on the relations between hormones, vitamins and enzymes. Some original plates make up a volume that must remain as a source-book of information for some time. Incidentally, the book is the first of a new series of monographs on animal biology.

T. H. HAWKINS.

GEOPHYSICAL STUDY OF SUBMARINE GEOLOGY*

BY DR. E. C. BULLARD,

SMITHSONIAN RESEARCH FELLOW OF THE ROYAL SOCIETY

TWO thirds of the earth's surface are covered by water. Our direct knowledge of the geology of this area is derived from samples obtained by lowering grabs and similar instruments on to the sea bottom. To realize the inadequacy of this evidence we have only to consider how little we should know of the past history and structure of the continents if our information were confined to that which could be obtained from a few thousand samples of surface soil collected from points scattered over the earth. In recent years a number of methods have been developed for finding out something about the form, constitution, and structure of the rocks hidden beneath the sea. These methods form part of geophysics, that is to say, they involve the application of techniques derived from physics to solve problems about the earth.

By merely examining a map of a piece of country, it is often possible to say something of its more recent history, for the form of the surface is a consequence of its constitution and history. Further, an adequate map is an essential basis on which to plot lithological and structural information.

The first problem of submarine geology is therefore to devise methods of making maps of the ocean with a detail and accuracy comparable with the maps of land areas. In doing this, two things have to be determined, (*a*) the depth of the sea, and (*b*) the position at which the depth is measured. The measurement of depth is easily and rapidly carried out with the echo sounder. In the type of instrument developed by the Admiralty, a pulse of supersonic sound is produced by a magnetostriction oscillator attached to the bottom of the ship. The sound travels to the bottom of the sea where part of it is reflected. The reflected part returns to the oscillator, which acts as a microphone and records the arrival of the pulse on a moving piece of paper. In this way a continuous record of the time taken for the echo to return can be made, and if the velocity of sound in sea water is known, this gives a continuous profile of the route over which the ship has steamed.

The determination of the position of the ship when the sounding is made is considerably more difficult if the ship is out of sight of land. Wind and currents soon cause a course steered by dead reckoning to become uncertain by several miles, and astronomical position finding can involve considerable errors and is not always possible. To overcome these difficulties the method of 'taut wire' control has been developed. In this method a number of mutually intervisible buoys are laid, and the distances between them determined by running out piano wire from a drum on the ship and measuring the length run out by passing it over a measuring sheave. This method gives an accuracy of the order of one in a thousand, but is too elaborate to use for any purpose beyond the fixing of the positions of a few control points for use in the detailed survey. The position of the ship when taking a sounding may be found by observations on three buoys in known positions, but this requires good visibility and a close network of buoys.

To obviate this difficulty, the United States Coast and Geodetic Survey has developed the method of 'radio-acoustic ranging'. A small bomb is thrown from the ship the position of which it is desired to determine. The sound from the bomb travels through the sea and actuates a microphone suspended from a buoy. The microphone is connected to a wireless transmitter in the buoy which signals the instant of arrival of the sound. Thus, if the original explosion and the arrival of the wireless signal are recorded on the ship, the time interval between them will give a measure of the distance of the ship from the buoy. If there are two or more such buoys in known positions, the position of the ship may be found with an accuracy of a few tenths of a mile. In the practical application of this method, a bomb is thrown overboard about every six minutes, so that the position of the ship is found about once every mile. In the past few years, the greater part of the waters around the United States have been mapped by such methods out to the thousand-fathom line.

The seas around the continents almost invariably consist of a comparatively shallow 'Continental Shelf' sloping very gently to 100 fathoms in a distance of 50–200 miles, that is, with an average slope of a tenth to a fortieth of a degree. At about the 100-fathom line, the slope suddenly steepens to about 4°, and in a few miles the sea deepens to 1,000–2,000 fathoms. The American surveys give a map of this area on a scale of two miles to one inch. These maps have brought to light several remarkable features. First, there is a very sharp demarcation between the shelf and the slope at its outer edge ; when sailing outwards from the continent the sudden change of slope is very conspicuous on the echo sounder, and its start can be placed on the record within a few hundred yards. Secondly, the sloping edge of the shelf is cut into by a remarkable series of submarine valleys. The existence off the coast of America and elsewhere of these valleys has been known for many years, but it is only recently that much attention has been paid to them. They are steep-sided features generally with flat bottoms, often lying several thousand feet below the level of the sea bottom on each side.

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* Substance of a Friday Evening Discourse delivered at the Royal Institution on April 26.

The origin of these features has been the subject of considerable controversy. It has been maintained that they were cut by rivers at a time when the level of the sea was much lower than at present. The recent surveys, which show the valleys to extend to the 1,000-fathom line, make the necessary lowering of the sea so great that this hypothesis must be abandoned. The difficulties of supposing the land to have been raised 6,000 ft. and lowered again are no less severe. Such a change must have left its mark on the flat-lying sediments of the coastal plain and have caused changes in the drainage which would be apparent in the present-day physiography. We are therefore compelled to believe that the valleys were formed under the sea. Unfortunately, very little is known of submarine erosional processes, largely owing to the lack of detailed surveys and to our scanty knowledge of the nature of the rocks forming the submarine topography..

It is, in fact, not possible to discuss these questions profitably without more information about the nature of the rocks forming the sea floor. Cores up to ten feet long have recently been secured from these rocks by firing a tube into the bottom from a gun lowered from a ship. Such methods are of great importance, but we can scarcely hope to obtain by their aid information about rocks more than a few tens of feet below the bottom of the sea. To penetrate deeper, indirect methods must be used. The most promising of these is the seismic method. In this, charges of explosive are detonated on the sea bottom and the elastic waves produced are recorded by seismographs also placed on the bottom. When an explosion is made, waves spread out from it in all directions, and from the time taken for the waves to travel a known distance their velocity may be found and an indication obtained of the nature of the rock through which they have travelled.

Reflexions of waves from the interfaces between hard and soft rock may also be observed. If a layer of a soft rock in which the velocity of the waves is relatively slow overlies a hard rock in which the velocity is high, it is possible for a wave to travel down to the hard rock, along in it, and up again in a shorter time than it can traverse the direct path through the soft rock. It is on the observation of such 'refracted' waves that the work done at sea depends. Measurements have been made off the eastern coast of the United States, and to the west of the British Isles, with broadly similar results. In the case of the British Isles, igneous and well-consolidated sedimentary rocks are exposed on land, and measurements at sea near the shore show them to be covered by only a few feet of recent sediments. On going farther from shore the thickness of the sediments increases steadily until at the 100-fathom line about 150 miles out to sea, the hard rocks are buried beneath more than 8,000 ft. of sediments. Beyond this it was not possible to go with the facilities available, but if the surface of the hard rock be extrapolated for a few miles, it runs over smoothly into the floor of the deep ocean.

It therefore seems that the Continental Shelf is a mass of sediments lying on a gently sloping surface of solid rock, and that the edge of the shelf is simply the edge of the sediments and does not represent a fault line dividing the ocean from the continent. This suggests that the Continental Shelf is growing seaward by deposition of the sediments worn from the land, the level of its surface being determined by the level at which the sediments can just rest without being disturbed by currents and wave motion. If this picture be correct, a particle of sediment brought down by a river is washed hither and thither on the sea floor until at last it comes to rest beyond the edge of the Shelf in water so deep and still that it can no longer be moved. It is probable that such a process would result in the deposition of sediments at an angle too steep for stability and that landslips would occur producing the jumbled topography typical of the edge of the Shelf. Great masses of rocks showing signs of contortion while plastic would also be produced ; such rocks have been found in many parts of the world, and may well have been produced in this way.

Measurements of gravity over the Continental Shelf should also give useful information. Unfortunately, only a few measurements have so far been made ; these show, rather unexpectedly, that the sediments are in isostatic equilibrium ; that is to say, the crust has sunk under their weight, until it is in equilibrium.

Present technique can give much information about the geology of the shallow seas, but these form only a small proportion of the whole. The outstanding problem is to develop accurate methods of position-finding far out at sea, so that accurate surveys can be carried out in mid-ocean, and to develop a variation of the seismic method that can be used in deep water. A start has been made with this work, and when conditions again allow experiments at sea, there is little doubt that rapid progress will be made. The problems to be studied are of great importance for geology. The mapping of a section of the mid-Atlantic Ridge, for example, together with determinations of the velocities of elastic waves in it, could not fail to yield results of great interest. We know already that it includes features which are on a scale comparable with the Himalayas, and such a survey would indicate whether these mountains were a folded range that had never been exposed to denudation, a sunken land mass, or a system of submarine volcanoes. The major rival geological theories, such as the permanence of ocean basins and Continental Drift, involve theories about the oceans. As they are derived almost entirely from data obtained on land, the study of the other two thirds of the earth's surface may be expected to be illuminating.

BORON IN AGRICULTURAL AND HORTICULTURAL PRACTICE

DURING the past year some three hundred and fifty papers and articles relating to the uses of boron compounds in agriculture and horticulture were published in twenty-one different countries. Nearly half of these contributions were made in the United States, where the rapidly growing interest in the subject was particularly marked. According to a recent report, boron investigations covering a wide range of soils and crops are now in progress in at least twenty-six American States. Important among the new findings published in the United States during the year was the efficacy of applications of boron to the soil in controlling canker disease, also termed girdle or internal black spot, of table or canning beet. The disorder appears to be closely related to heart rot, the well-known boron deficiency disease of sugar beet and mangolds. Canker is said to be very prevalent and of considerable economic importance in the canning beet growing districts in the States of New York, Michigan, Oregon and Wisconsin. Its presence has also been observed in Washington State.

The beneficial use of boron on daffodils was reported from North Carolina, and further advance was made in New York State in the study of internal bark necrosis of apple trees and its control by the application of boron. A first progress report on drouth spot of prunes was also issued in the latter State. The first recorded instance of boron deficiency in cabbage and related crops, under field conditions, was reported from Wisconsin. The disorder, an internal breakdown of the stem in the region of the core, was largely controlled by the application of boron. In Florida, the condition of citrus trees in several groves is considered to suggest a lack of boron. An investigation of this possibility has been begun. An apparently new disorder of tomato plants, experienced in New Jersey, and characterized by a form of yellowing of the leaves, was controlled by suitable applications of boron. In the same State, the first recorded symptoms of boron deficiency in roses grown in sand cultures were described.

Three important reviews of literature were published in the United States during the year. The first supplement to the American Potash Institute's Bibliography of Literature "Boron as a Plant Nutrient" was issued in May and listed 171 papers reviewed during the period July to December, 1938. The Chilean Nitrate Educational Bureau Inc., New York, published the third edition of its well-known "Bibliography of References to Literature on the Minor Elements". This lists 449 papers relating to boron. A booklet entitled "Boron in Agriculture", published by the Pacific Coast Borax Company, New York, presents a concise and well-illustrated review of work conducted in the United States and Canada.

In New Zealand and Australia the list of crops which may suffer from boron deficiency under field conditions was also extended. In the former country, workers at the Cawthron Institute found that a disorder of apricot fruits, which is sometimes prevalent in the orchards there, is due to lack of boron and can be controlled by the addition of boron to the soil or by spraying it on to the tree. The disorder in question has been termed 'brown spotting'. Further investigation of the subject is in progress. In Queensland, Australia, a condition of young pineapple plants, known as 'crookneck' (so called on account of the manner in which the heart leaves are twisted) was largely controlled by spraying the plants with boron. Progress was reported from New South Wales concerning the investigations being conducted there on needle fusion of pines. The application of boron to diseased trees has given complete or partial recovery in some cases, but in others has so far been without result. This disorder of pines also received further attention in Great Britain, where it was shown that the leaves of affected trees contained consistently less boron than did those of healthy trees. The results of additional investigations concerning the control of brown heart of swedes in New Zealand by the use of boron were reported. It was stated, too, that the use of boron for the control of cork disorders of apples in New Zealand is likely to have wide application in the Alexandra district of Central Otago.

Other notable contributions came from the Dutch East Indies and Holland. The symptoms of boron deficiency in coffee have been studied at the Besoeki Experiment Station in Java, and similar investigations on potatoes under both laboratory and field conditions were carried out in Holland. French workers extended their investigations to a study of the boron content of various types of soil, and have published their first results. Work in Canada related to swedes and turnips more particularly, and the use of boron there on additional crops is now being studied.

The Institute for Tobacco Research of the German Reich has investigated the essential nature of boron for the healthy growth of tobacco. As a result boron has been applied to its tobacco fields for some years, with good results. The well-known German worker, Brandenburg, published early in the year a review in German of available information concerning the use of boron in plant nutrition, with special reference to his own investigations. It was also reported from Germany that the production of borated superphosphate for use on the sugar beet crop in 1938 was 30,000 tons, compared with 20,000 tons in 1937. Another noteworthy feature was the publication by several workers in the United States, in Germany and in Great Britain of methods relating to the determination of boron in soils, plants and fertilizer materials.

Important developments, in addition to those already mentioned, took place in the British Isles. Further successful results relating to the control of brown heart in swedes and turnips by the use of boron were reported from Northern Ireland, the north-east of Scotland, and the north-west of England, in experiments carried out in 1938. These were the first investigations in the areas concerned. The disease was also reported to have been prevalent in Devon and Cornwall. In an experiment in Scotland in 1938, boron (applied as 'Boronite') gave a large measure of control of internal rust spot of potatoes.

Special mention must also be made of the publication early in the year, of the third of the reviews "Boron and Plant Life" (*Fert. Feed. J.*, February–April, 1939.) This review, written by A. C. and R. W. G. Dennis, summarized developments reported in some two hundred papers during the latter half of 1937 and in 1938. The article was later published in French.

The foregoing is naturally only a brief outline of some of the more important items of information reported. It may serve, however, to indicate the wide range and extent of investigational work on boron now in progress and to record the more important advances recently made.

SOME EXPERIMENTS IN RABBIT CONTROL

BY R. M. LOCKLEY,

SKOKHOLM ISLAND, PEMBROKESHIRE

ATTEMPTS have been made over a period of twelve years to control and if possible exterminate the wild rabbit *Oryctolagus cuniculus* on the island of Skokholm, Pembrokeshire, so as to reserve pasture for other livestock.

Skokholm is composed almost entirely of Old Red Sandstone rising to an average height of 100 ft. above sea-level, is rock-bound, and often inaccessible in bad or moderate weather owing to its exposure to the strong Bristol Channel tides and the open Atlantic. The island was once a general farm (1800), but is now covered with rough grazings of rabbit-worn turf, heather, bracken and thrift. There are about 200 acres of rough grazings and some 42 acres of broken-up cliff ground and outcropping rock. So far back as 1324 rabbits were marketed from the island ("Inquisition post mortem" of Aymer de Valence, Earl of Pembroke. 18 Edward II, No. 75), and later records show no break in the occupation of the island by rabbits up to the present day. This isolation in an exposed situation over centuries has produced a type weighing about four ounces less than the typical rabbit on the mainland of Pembrokeshire, from which the present-day Skokholm rabbit further differs in possessing a more plentiful admixture of black hairs on its upper parts.

The broken-down nature of the cliffs affords ideal refuge in the heaped-up boulders and talus, and makes control work difficult. While, owing to the use of all holes and burrows on the island by nesting sea-birds over a protracted breeding-season, treatment of burrows has to be confined to the three months November–January.

MECHANICAL CONTROL

During 1927–28, twelve dozen steel-toothed traps in daily use caught 2,415 rabbits—approximately two thirds of the estimated population. In 1928–29, twenty-four dozen traps and 120 wire-noose snares caught 2,908 rabbits, again leaving about one third on the ground. It was found that traps were too slow to catch sufficient numbers in a limited time, and in both winters considerable numbers of wild birds were trapped and so killed. Traps were given up as being inefficient and inhumane. Snares could only work successfully in the few flat and wide areas where rabbits could run fast enough to draw them. Snares fitted with various 'humane' devices were proved too clumsy and conspicuous to be successful. Nets and fence-netting traps were successful only in the flat, open meadows, but were useless in the major portion, which consists of a honey-comb of bird-burrows in rough ground.

Ferrets were unsatisfactory, possibly because for centuries rabbits on Skokholm have known no underground enemies such as the stoat and weasel, and they would not bolt in sufficient numbers.

During the years 1931–36, rabbits were not worth more than 2*d.* or 2½*d.* per lb., and could not have been economically marketed even if they had been caught. They were therefore allowed to increase almost unhindered and soon reached a climax state of about 10,000, the natural increase of summer or its equivalent dying out each winter from natural causes, it is believed chiefly from diseases associated with overcrowding and malnutrition, the common fate of rabbits on many small islands where no human control is attempted.

DISEASE

In the summer of 1936, Sir Charles Martin suggested that the introduction of the virus disease *Myxomatosis cuniculi* might be effective in controlling the population of rabbits. He had found that this malady was 100 per cent fatal to wild rabbits, and in two experiments the disease had exterminated colonies living under natural conditions in an enclosed area of 500 sq. yards in a paddock at Cambridge[1]. The virus of Myxomatosis had been tested upon a variety of domestic animals and wild fauna in the United States, England and Australia and, so far, found to be entirely specific for the European rabbit. The disease produced by it has an incubation period of 5–10 days, at the end of which time the animal becomes feverish and ill, and the eyelids and the nasal mucous membranes become swollen and inflamed. Afterwards a purulent fluid is exuded from the conjunctivæ and nose. Sometimes the mucous membranes at the anal and generative orifices are similarly affected. The exudation from all these situations contains the virus and the infection passes to other animals by contact.

During the last two weeks of September, 83 rabbits were marked, inoculated and released at points scattered over the whole island; 12 of them were afterwards discovered dead in the open. Unfortunately, it was not possible to make this first attempt earlier in the year, so that rabbits infected from those inoculated would not be likely to be found dead before October 4, when the island was abandoned for the winter. It is, therefore, not possible to say to what extent spread of the disease occurred; but when the island was visited in the following spring, there was no trace of the disease in a population which seemed as numerous as ever.

A second attempt was made during the summer of 1937, when 55 rabbits were inoculated with the virus and distributed as widely over the island as before. It was hoped that closer contacts in the breeding season would result in the wider spread of the disease. Both marked and unmarked individuals were found dead of the disease, proving it had spread somewhat; but it appeared to have died out by September, and with no obvious effect on the numbers of the rabbits. A final inoculation of seven rabbits in one warren in the spring of 1938 had the same result—the disease spread but soon died out without exterminating all the members of the warren. Sir Charles Martin had shown that with the strain of virus used intimate contact of healthy and sick animals was required to ensure transmission of the disease, and it may be that the instinctive behaviour of the sick animal in isolating itself and squatting about in the open at the most contagious period was responsible for the failure of the virus as a means of control under natural conditions.

FUMIGATION

Smoke pumped into burrows from a cartridge containing sulphur was found expensive, difficult to handle, and produced a painful death. In 1938 the Universities Federation for Animal Welfare (then the University of London Animal Welfare Society), through Captain C. W. Hume, arranged to make the Skokholm rabbit population the subject of a demonstration of humane rabbit control, using calcium cyanide in the dust form known as 'Cyanogas'. The dust is blown through the passages of warrens by means of hand-pumps, and on contact with the air, gives off the fatal hydrocyanic acid gas. As the dust emerges from exits in a warren, these are blocked so as to ensure concentration of the gas within.

Work was begun in the winter of 1938–39, when tests made on rabbits in rock crevices and shallow holes proved that death occurred within a few seconds, the animals stretching out without excessive movement and without screaming. All the accessible holes were then closed, as so many were bird-holes only. The re-opened holes were treated a fortnight later with the dust, and it was possible to fumigate all holes except those in the steepest parts of the cliffs and among cliff-falls and boulders. When this first treatment was completed, it was estimated that about 90 per cent of the rabbits had been killed. Rabbits from the cliffs seemed to be responsible for many holes afterwards found re-opened inland, and it is probable that had the island been connected with the sea without cliff or boulder 100 per cent extermination would have been achieved.

As it is, after the holes had been gone over for a third time, it was calculated that only about 400 of the original 10,000 (in round maximum figures) rabbits were left, and all of these appeared to be rock-dwellers coming to the top of the island to feed only at night. On this showing, 'Cyanogas' was therefore 96 per cent successful for the island as a whole; excluding the economically untreatable cliff-land, it was still nearer complete success.

Proof of this success was forthcoming in the summer of 1939. White clover appeared where it was always rare and stunted before, grass grew long and luxuriantly, and the absence of rabbit-pellets was remarked. As much as four tons of hay were cut off an acre of the best land; and hay had not been cut since the land was farmed in the last century. The grass continued to grow; one hundred sheep imported in the autumn were found quite inadequate to graze it down and it was eventually beaten down by winter storms.

The residue of rabbits in the cliffs began to breed with rapidity. Normally, under climax conditions, the island rabbits only breed from March until July inclusive. At present they are breeding all the year round as a result of the abundant feed. During the summer of 1939 they spread somewhat inland, helped by the sea-birds, which opened all the blocked holes in that spring. Control has again been carried out this winter by means of 'Cyanogas', and at the moment of writing, the population is again reduced to a residue of rock-dwelling rabbits.

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[1] Martin, C. J., *Univ. Cambridge Inst. Animal Pathol. Report*, 4, 16–38 (1934–35).

OBITUARIES

Prof. A. G. Högbom

Prof. Arvid Gustaf Högbom, who died on January 19 at the age of eighty-three years, had been a leader in geological work and thought in Sweden for more than half a century, and he came to occupy a dominant position among the geologists of his native land similar to that of his contemporary the late Prof. W. C. Brøgger in Norway (see Nature of April 27, p. 652). A student at Uppsala, Högbom was appointed lecturer there in 1885. In 1891 he joined the staff of the University of Stockholm, but returned to Uppsala in 1896 as professor of geology and mineralogy, occupying the chair until his retirement in 1922; he continued active in investigation and writing until the end. He was born in northern Sweden, most of his field work was carried out there, and he was ever active in promoting the economic development of this sparsely populated region.

Högbom's work was mainly concerned with the Pre-Cambrian and the igneous rocks, the ores, glacial and geomorphological problems, and in latter years with historical and philosophical aspects of the science. Many of the views now widely held regarding Swedish geology were propounded by him, and they had considerable influence in shaping the thought of workers in other lands. The following is a selection only of the subjects on which Högbom made important contributions: the magmatic origin of the iron ores of northern Sweden, the Caledonian overthrusts, the nepheline syenites and associated rocks, the sub-Cambrian peneplain, the Norwegian coastal platform, glacial and fluvio-glacial erosion, the glacial lakes of Sweden, the significance of the clay 'varve', solifluxion, the post-glacial uplift of Scandinavia and the sequence of its climatic changes. Vol. 15, 1916, of the *Bulletin of the Geological Institution of the University of Upsala* was dedicated to him on the occasion of his sixtieth birthday, and the bibliography of 145 items given there bears witness to the remarkable range of his studies.

Högbom was an active participator in international geological congresses, and he will be remembered as a prominent figure at the Congress in Stockholm in 1910. The Geological Society of London honoured him by electing him foreign correspondent in 1911 and foreign member in 1927. L. Hawkes.

Prof. V. I. Sihvonen

One of the first victims of the recent Finnish-Russian War, killed on November 30 during an air raid on Helsinki, was Prof. Väino Ilmari Sihvonen, professor of physical and electro-chemistry in the Tekniska Högskolan of the University of Helsinki. Born in Kangasniemi in 1889, he became a student at Viborg in 1907, a lecturer at the Helsinki Technical High School in 1923, a teacher at the University in 1925 and in 1936, the first holder of the chair of physical and electro-chemistry in the University. He also worked as a student at Dresden, Breslau, Copenhagen and Zurich.

Sihvonen's scientific work was concerned almost exclusively with the oxidation of carbon. Inspired by Langmuir's experiments upon the combustion of carbon filaments in oxygen at low pressure, Sihvonen attempted by similar, more elaborate methods, to gain a deeper insight into the primary mechanism of carbon oxidation. He carried out both static and dynamic experiments, the results of which are published in a large number of papers which have appeared since 1930. In order to explain the relative amounts of carbon monoxide and dioxide formed in these experiments he elaborated a detailed theory which involves the formation of ketone and ketene groupings on the border carbon atoms. His studies included experiments upon the oxidation of graphite and diamond by oxygen in the presence of X-radiation, and the oxidation of carbon by steam and in fused electrolytes. He also made a study of the electrolytic oxidation of tartaric acid and alkali tartrates.

Sihvonen visited Great Britain as recently as 1938 on the occasion of the Faraday Society's general discussion at Bristol upon "Chemical Reactions Involving Solids" when everyone was impressed by his quiet, friendly, unassuming manner. He was a member of the Suomalainen Tiediakatemia and had rendered his country great service in the Finnish war of independence. His tragic death deprives Finland of an outstanding scientific worker and a distinguished teacher.

Mr. J. A. Hobson

John Atkinson Hobson, who died on April 1, was one of the most distinguished among British economists, although he never held any regular academic post and had to wait until the last years of his life for his fellow economists to recognize the importance of his work. Born at Derby on July 6, 1858, Hobson, on leaving Oxford, spent seven years as a schoolmaster, and thereafter for ten years was engaged chiefly in extension lecturing and teaching for the Universities of London and Oxford.

The first book published by Hobson, "The Physiology of Industry" (1889) was written in collaboration with the late A. F. Mummery, well known as business man and Alpine climber; and it contained the germ of his later work. Hobson was already putting forward in 1889 that theory of 'underconsumption' which was for many years to be ridiculed by the great majority of professional economists, though the very great element of truth contained in his theory has in recent years been widely appreciated, and there is a close resemblance at a number of points between his doctrines and those enunciated by Mr. J. M. Keynes in his more recent work. Hobson developed his views in many later books, among which the most important are "The Industrial System" (1909), "The Science of Wealth" (1911) and "Work and Wealth: a Human Valuation" (1914).

In the general approach to economic problems, Hobson was greatly influenced by Ruskin, and he treated economics not as a self-contained science, but rather as a branch of social science as a whole. His works contained much acute criticism of the narrowness of modern orthodox economic theory, and he was continually insisting on the need to approach economic problems from the point of view of human welfare in the broadest sense. Outside the field of economic theory he wrote widely; and at least two of his books have become historical classics. These are "The Evolution of Modern Capitalism" (1894) and "Imperialism" (1902). They remain the most penetrating studies yet written in their respective fields.

During the War of 1914–18, Hobson was actively associated with the Union of Democratic Control, in which he continued to take a lively interest up to the time of his death. He wrote extensively for the *Manchester Guardian*, and was for a long time one of the leading theorists of advanced Liberalism. In his later years, however, he had come to accept a Socialist position, led thereto by the conviction that the capitalist system was essentially restrictive in its working, and was therefore incapable of emancipating itself from the vice of underconsumption.

Hobson, on several occasions, lectured in American universities: indeed, his work was, until quite lately, much better appreciated in the United States than in Great Britain. Personally, he was a man of exceptional charm, with a very lively wit and great capacity for friendship. His series of war-time dialogues, published in the *Nation* during the War of 1914–18 under the name "Lucian", showed how wittily he could write when he chose.

G. D. H. Cole.

Colonel C. T. Green

The death of Colonel Conrad Theodore Green, in his seventy-seventh year, at Birkenhead on April 17, removes one of the best known of Merseyside botanists, for at his own cost and initiative he edited the 1902 and 1933 editions of "The Flora of Liverpool". An active member of many national and local societies, he was a past president of the Liverpool Botanical Society and other societies, and on the executive council of Flora's League he assisted Sir John Abbot-Anderson in the national protection of wild plants by lecturing in numerous parts of the country.

Born at Kirkburton, West Riding, in 1863, Dr. Green obtained a medical practice in Birkenhead in 1887; he was elected to the Linnean Society in 1901; and, after pre-War duty as medical officer in the Territorial Army, he was promoted Colonel, Army Medical Service, in 1915. In 1905 the Chester Society of Natural Science awarded him the Kingsley Medal, for botanical research. He made a long series of microscope slides of micro-fungi attacks upon plants for that Society.

NEWS AND VIEWS

War in the Low Countries

LAST week saw a further extension of the theatre of war in Europe. The Germans, in flagrant defiance of all the rules of international law and courtesy, invaded Holland, Belgium and the Duchy of Luxembourg without any warning whatsoever. The blow was not unexpected, but the manner of its delivery was marked by the callous disregard for all human rights and values which has characterized the Nazi regime and is now seen in its full hideousness. It is not our purpose, even were it possible, to record the progress of the War, but reference must be made from time to time to definite stages of a catastrophe which is affecting the life of every human being in Europe and in many countries outside Europe itself.

As President Roosevelt pointed out in his address on May 10 to the Eighth American Scientific Congress which had just opened in Washington, men of science are not responsible for the misuse of the discoveries of peace to dominate hundreds of millions of people, and there will be universal approbation for the further comment that scientific workers as a whole are prepared to "act together to protect and defend by every means our science, our culture, our freedom, and our civilization". The suppression of individual and intellectual freedom which is being extended through Europe by the hammer-blows of war must be resisted by every means in our power, and the war must be carried to the enemy with the utmost scientific efficiency in the sure hope that, by so doing, we may shorten the period of suffering which is now upon the world.

Advisory Research Council of the Chemical Society

AT the annual general meeting of the Chemical Society held on April 4, the president, Sir Robert Robinson, dealt at some length with the activities of the Advisory Research Council of the Chemical Society which was formed in September 1939, its object being to act as a liaison between chemists engaged in unremunerated research who are seeking guidance as to subjects for investigation of potential value to the national war effort and Government departments or industrial organizations in a position to suggest such topics. Sir Robert said that the response to the suggestions made and invitations issued by the Advisory Research Council has been very gratifying, and that he is sure that the initiative will continue to receive the generous support of the Society's fellows. The situation in regard to scientific research in its application to the War is very different from that of 1914. This is due, partly to the effort made in the War of 1914–18 itself, partly to the intensive work of the intervening years, and in part to the unanticipated course of the present emergency, which has not yet thrown up so many new problems as might have been expected. Nevertheless, there are clear indications that the original work of research chemists will be needed in the present struggle, possibly to a greater extent than in the past, and the relative slowness of the start should deceive nobody in regard to the vitally important part which may be played by the Chemical Society. Certain research committees under Government auspices are already showing a marked tendency to make full use of the Society's facilities in connexion with the longer-range investigations in which they are interested.

It has been laid down by the Advisory Research Council of the Chemical Society that the only subjects to be studied should be such as have a definite relation to the conduct of the War. It is, however, generally agreed that the maintenance of our export trade in a flourishing condition is of the utmost importance, and therefore the Council is prepared to assist the chemical industry so far as lies in its power. Here the attack must be on a broad front and, as it is impossible to spot the winners before the race, there must be losers also. Co-operative effort is essential, and this reflection should console those who are unable to see in what way the suggestions made to them could have any influence on the fortunes of the nation. Fellows may rest assured that more urgent needs will be made known to them when they become apparent to the Council, and all suggestions of a specific nature are welcomed and carefully examined. The Council does not supervise or direct work undertaken at its suggestion, and the results may be used or published in any way that the investigator desires, subject of course to his own private commitments to firms which may have given material assistance or confidential information. Similarly, it can accept no responsibility for the accuracy of the work or for losses sustained or accidents to personnel. As an advisory body the Council is prepared to give any assistance in its power to investigators who wish to ensure that their work is utilized to the full in the national interest. When work is undertaken on behalf of a Government department, this fact is clearly stated, and fellows need not be reminded of the existence of the Official Secrets Act. The Council has no funds at its disposal, but workers on projects suggested by the Council may make application at any time to the Research Fund Committee of the Society. Finally, Sir Robert emphasized that the Council is always available for consultation if any fellow is doubtful of the proper procedure at any stage of his work.

Electrical Invention and Re-Invention

IN the course of his work at the Science Museum, South Kensington, Mr. W. T. O'Dea has had occasion to examine the history of many notable inventions; he gave an account of some of his investigations in a paper bearing the title "Electrical Invention and Re-Invention" read to the Newcomen Society on March 13. His paper contained sections treating of electric lighting, the dynamo, the accumulator, wireless telegraphy, the loud-speaker, television and other subjects. There were instances, he said, of phenomena explored not far enough, or discovered and not fully appreciated. Some inventions, too, lay dormant pending the discovery of a necessary, but ancillary device, or the growth of conditions suitable for their development.

Much interest lay in the story of the dynamo. The first proposal for a self-exciting machine appears to have been made by Sören Hjorth, of Copenhagen, in a patent of 1855. In 1861, another self-exciting machine was proposed by Ányos Jedlik of Budapest, but these proposals led to no development. In 1863–65, Henry Wilde, of Manchester, built machines so nearly self-exciting that it seemed amazing that he should not have continued further. In a paper to the Royal Society in 1866, Wilde wrote that "an indefinitely small amount of magnetism or dynamic electricity is capable of inducing an indefinitely large amount of magnetism", given, of course, the expenditure of mechanical power. In 1866, too, Varley patented a self-exciting machine, but then lost interest in the subject. It was left to Wheatstone and Siemens to describe their self-exciting machines in 1867, but the principle of self-excitation had been discovered and re-discovered three or four times. The paper was illustrated with slides of some of the historic apparatus from the Science Museum.

Water-Power in Durham

A SCHEME for utilizing water-power in Upper Teesdale to generate electricity is put forward by Mr. G. F. Kennedy, who has investigated the matter for the South-West Durham Development Board. According to the *Electrical Review* of May 3, his report has been considered by the Executive Committee of the Board, which has submitted it for Government consideration. The potentialities of the waterfall at Cauldron Snout have been investigated, the object being to facilitate by a cheap supply of electricity the development of industries in Teesdale and Weardale. The report traces the course of the Tees from its source on Cross Fell. Basalt rock forms a natural dam capable of holding 1,250,000 cub. ft. of water, and the overflow from this dam forms the Cauldron Snout cascade into a ravine 135 ft. deep. Mr. Kennedy suggests that as the catchment area extends over 20 square miles a plentiful supply and head of water are assured. It is proposed that the volume should be augmented by the construction of an eight-foot concrete dam, which would increase the natural storage by a further 2¼ million cub. ft., making a total of nearly 4 million cub. ft.

A suggested hydro-electric scheme capable of producing approximately 2 million electric units annually is outlined. At Langdon Beck, Mr. Kennedy suggests that a charge-engineer's house might be built for the control and maintenance of a power station. A pipeline of 28-in. diameter steel pipe 1,200 ft. in length, housed in a concrete duct or tunnel in order to protect it and to avoid spoiling the amenities of the district, is advised, and this, as well as the dam, could be surfaced to resemble the natural contour and appearance of the surrounding terrain. The volume of water thus secured would be able to operate a 21-in. diameter twin-impulse type directly coupled turbine to a 150 kw. alternator. The annual overhead and maintenance costs of the scheme, which would require the services of only one regular attendant as it would be automatically controlled, are calculated to yield a supply at an average cost of a farthing per electric unit.

Transmission Lines on the French Grid

AN article on "Transmission Lines on the French Grid" by D. J. Tynan-Byrd is published in the *Electrical Times* of April 25. The building of the French grid scheme was begun soon after the War of 1914–18, when, owing to the increased industrial and domestic load in different parts of the country, the demand for new generating stations and transmitting stations became urgent. In France, the coalfields lie to the north, and here steam generation to produce electricity is most commonly used. In the southern half of the country, there is abundant water-power available in the Rhône district, in the regions of the French Alps and the Pyrenees, particularly in the spring and summer months when the glaciers begin to melt. The area of France is more than 200,000 square miles, and some regions of dense population possess no facilities for generating electrical energy, while the regions where facilities are abundant often possess few local inhabitants. Hence the policy adopted is to transmit power from areas where it can be generated cheaply to areas where it is in demand.

When a hydro-electric station is built, if no water-storage facilities are available, the station is practically always used for base-load-purposes. If, however, a dam can be constructed, the station will normally be used for peak-load supply. The building of the line is usually arranged and financed by a company which is formed by all the concerns interested, such as power undertakings, railway companies and industrial firms. The Ministry of Public Works, which is equivalent to the Electricity Commissioners in Great Britain, takes a controlling interest in these companies and sees that lines are not built unnecessarily and that they are not duplicated. In some thickly populated areas, where the erection of overhead lines is inadvisable, oil-filled underground cable has been installed. The operation of some of these stations is very ingenious as some of them are 'remote controlled' from larger stations nearby. In some cases, even when the distance of the power station from the distributing area is about ten miles, the whole operation of opening the water valves synchronizing the alternators and finally placing them on load is performed by remote control methods.

The Antarctic *Snow Cruiser*

THE *Engineer* of May 3 gives an illustrated description of the remarkable vehicle which has been constructed for use by the American Antarctic Expedition which sailed from Boston, Mass., on November 15, 1939, in command of Rear-Admiral

R. E. Byrd, U.S.N. The vehicle, called the *Snow Cruiser*, is to be used as a mobile base, and it is reported to be capable of travelling across ice fields, of climbing gradients of 35 per cent, of sliding down them on its steel-ribbed under-floor and of crossing crevasses in the ice 15 ft. wide. The *Snow Cruiser* is more than 55 ft. long, 20 ft. wide and 15 ft. high, and weighs, fully equipped, 33½ tons. It has four pneumatic-tyred wheels 10 ft. in diameter which can be turned independently to various angles, and which can also be retracted into the vehicle. The structure is of steel electrically welded, and the motive power consists of two 150 h.p. oil engines driving electric generators supplying current to the traction motors. In the interior are the living quarters, store-rooms, the engine room, a machine shop and a laboratory, and also tanks for the storage of 2,100 gallons of oil fuel and of nearly 850 gallons of petrol for the aeroplane carried on the back of the vehicle. The *Snow Cruiser* was designed and constructed by the Research Foundation of Armour Institute in Chicago, under the direction of Dr. T. C. Poulter, scientific director of the Foundation, who was second-in-command of the second Byrd expedition.

Puffin Crosses North Atlantic

ONE of the most important results of bird-ringing experiments is the first recovery in North America of a puffin (*Fratercula arctica arctica*) ringed in Europe. This was a specimen ringed by Lord Dumfries as a young bird on St. Kilda on August 10, 1939, and shot at Herring Neck on the north coast of Newfoundland on December 20, 1939 (*British Birds*, March 1940). The instances of European-marked birds traced to North America are very few. The most numerous records are of the kittiwake (*Rissa tridactyla*); specimens marked as young on the Farne Islands, Northumberland, have been recovered in autumn and winter months at Davis Strait, Labrador, and Newfoundland over periods since 1924; another specimen ringed at Khasilov Island, in the Barents Sea, was recovered at Little Fogs Island, Newfoundland. Black-headed gulls (*Larus ridibundus*) ringed at Rossitten, East Prussia, have been recovered in Mexico and the Barbadoes, and there is the celebrated record of Cumberland lapwings (*Vanellus vanellus*) shot in Newfoundland after a gale forced them from their normal migration to Ireland. Previous ringing returns of Scottish puffins have shown no marked westerly migration. Specimens from Northumberland have been recovered at Norway.

Effect of Winter Frosts on Bird-life

IN a lecture to the Hastings and St. Leonards Natural History Society on April 23, Mr. Eric Hardy described the serious effect upon the numbers of insectivorous British birds as a result of the severe frosts during the past winter, when, particularly in the north, vast numbers of thrushes, blackbirds, titmice and other birds were killed by the long absence of food and water. In recounting at length many of his ornithological studies in the north, Mr. Hardy stressed the possible effect of this partial loss of useful insectivorous birds at a time of national food-growing efforts, and the possibilities of increased wireworm damage to cornland, and cabbage white caterpillars to cultivated greens. There is a marked shortage of many of the residential insect-eating birds in woods in the north, although Nature has recovered from the severe winter toll of bird-life more rapidly than was anticipated and it will be interesting to compare the future results with previous hard winters. Nevertheless, there is an urgent need to protect and increase insectivorous birds by providing more nesting and feeding haunts, for example, growing more undergrowth in woods and plantations, and preventing loss of existing bird haunts by river pollution and heath fires.

Canada's Indian Policy

AN interesting review of the circumstances and problems of the Indian population of Canada was given by Mr. Diamond Jenness of the National Museum of Canada, at the recent meeting of the American Association for the Advancement of Science at Columbus, Ohio. The Indian policy of the Canadian Government was framed at a time when to civilize in accordance with the white man's ideals, rather than to conserve, was the aim of liberal and humanitarian administration. Further, it was considered inevitable that such backward peoples would be unable to withstand the difficulties and dangers of contact with civilization and must become extinct. Hence Canadian policy was fusion of the two populations rather than segregation. The Indian was gradually to be absorbed by the white.

Of recent years, however, in Canada, as in other parts of America, the Indian population is increasing; but a more or less successful adaptation to changed conditions, if it has not actually contributed to the increase, as is probable, has certainly averted untoward consequences. This is implied in the comment by Mr. Jenness that the Iroquoians of eastern Canada, "being an agricultural people, . . . were not forced to undergo any sudden revolution". Among the Plains Indians, in the difficult transition from buffalo hunting to growing wheat, the Blackfoot, now the most prosperous, had the advantage of being guided by able and far-sighted chiefs. The Indians of the Pacific coast, both in temperament and economy, have proved less capable of readjustment; but in the Arctic, as might be expected, the Eskimo show themselves well able to hold their own, while the women make excellent wives for the white pioneers who settle on this frontier.

Bureau of American Ethnology, 1938-39

THE major field research with which the Bureau of American Ethnology was associated in the fiscal year 1938–39 (Fifty-sixth Annual Report, 1938–1939, 1940) continued to be that of the United States De Soto Expedition Commission. For the greater part of the year Dr. John R. Swanton was in the field in the interests of the Commission or engaged in the preparation of its report. With various members of the Commission he visited points in North and South Carolina, Georgia, Florida, Missouri, Mississippi, Arkansas and Louisiana. The report has since appeared in a volume of 400 pages.

A joint expedition of the Bureau and the National Geographic Society, under M. W. Stirling, chief of the Bureau, carried out an excavation on a mound site at Tres Zapotes, Vera Cruz, Mexico. Nine major stone monuments were excavated and a large collection of ceramics and figurines obtained. The most important find was a Mayan stone monument inscribed with an initial-series date which apparently records a late Baktan 7 date and is thus among the earliest at present known. The style is closely related to the Tuxtla statuette. This important document has now been deposited in the National Museum, Mexico City. Among other researches, special interest attaches to the investigation of the northern provenience of the Navajo, the largest single-dialect Indian population in the United States, numbering some 50,000 souls, inhabiting Arizona and New Mexico. Their language is an aberrant form of Western Apache, belonging to a group of which the northern origin is patent and traceable as closely related to Athapascan tongues occupying the interior of Alaska and western Canada. Dr. F. H. H. Roberts, continuing his researches on the character and distribution of Folsom man in the period under review, has traced this early prehistoric culture so far north as Saskatchewan, along the postulated migration route of peoples coming from Asia into the New World.

Canadian Polar Year Expeditions, 1932–33

THE Second International Polar Year, 1932–33, during which many nations joined in the simultaneous recording of meteorological, geomagnetic and auroral data in the polar and other regions of the globe, belonged to an epoch when the nations of Europe and elsewhere could still devote money and energy to a great co-operative scientific enterprise. Though receding in memory, some of its fruits still remain ungarnered; this has now been accomplished, for the share of Canada in the magnetic and auroral part of that enterprise, by the publication of volume 2 of the report of the three Canadian expeditions (volume 1 deals with the meteorological results). A new magnetic observatory was set up for the year at Chesterfield Inlet (63·3° N., 90·7° W.), which is not far from the north magnetic pole—the magnetic needle at Chesterfield Inlet departs from the vertical by only 3·6°—and is also near the auroral zone, the centre of which is the pole of the earth's magnetic axis. In addition, the equipment of the Meanook Observatory, set up in 1916, was improved for the Polar Year work: Meanook (54·6° N., 113·3° W.) is also in a high magnetic latitude.

The report gives very full details, on an internationally arranged plan, of the magnetic observations made during the year at these two stations; the tables cover more than eighty quarto pages closely printed; they are likely to prove, for many years, valuable raw material for theoretical studies, as was the case with the records of the first Polar Year (1882–83), the value of which is still not exhausted. In addition, the report gives particulars of earth current observations at Chesterfield Inlet, and of magnetic measurements at field stations visited from Chesterfield; together with more than fifty pages of records and discussion of auroral observations made at Saskatoon and at Chesterfield Inlet; this part of the report is illustrated by many line diagrams and photographs of auroras. Height measurements were made by simultaneous photography from two stations separated by 112 km.; they showed that the most usual height of the lower edge of the auroras measured was about 100 km., as in Norway. Auroras extending below 80 km. were observed on at least one occasion.

Robert Mond Bequest to the British Museum

A FURTHER instalment of descriptive notes on outstanding objects in the collection of antiquities bequeathed to the British Museum by the late Sir Robert Mond (*Brit. Mus. Quarterly*, 14, 1; 1940) deals with funerary portraits of the Roman period from the Fayyum, an example of a theriomorphic vase possibly of the middle predynastic period in the form of a frog and two small granite heads, of which the smaller presents the remarkable and unusual feature that the eyes are shut, so that the effect is that of the portrait of a dead person, while the contour of the main features resembles that of a skeleton. It seems to be without parallel, and no opinion can be expressed as to its age without the greatest reserve. Much interest is attached to a small hollow cylinder of black and white porphyritic rock, which belongs to a class of objects of which the use has not yet been determined satisfactorily. At one time they were thought to be mace heads, though secure hafting seems an impossibility; but recent discoveries at Wadi Halfa, in which they were found in association with other weapons and in some burials with two fingers of the right hand, have led to the suggestion that they were archers' looses, and in their use resembled the Mongolian ring. All datable examples are from sites occupied by the people to whom archæologists apply the term the *X*-group, who occupied Upper and Lower Nubia from the third to the sixth centuries A.D., variously identified with the Blemmyer of the Eastern Desert, the Noubades, a mixed race of negroid and Meroitic elements, and the Nobatae, who are alleged by Procopius to have formed a buffer State between the Roman frontier at the First Cataract and the southern barbarian tribes.

Taxonomy in the Amaryllidaceæ

THE present trend towards specialization makes possible, and indeed necessary, a detailed volume such as *Herbertia*, the year-book of the American Amaryllis Society. The editor, Dr. Hamilton P. Traub, has brought together in the sixth book, for 1939, a collection of knowledge upon all matters pertaining to the horticulturally valuable members of the Amaryllidaceæ. There are the usual descriptions of exhibitions and garden culture, of grouping and floral artistry; there is a dedication of the present volume to the Union of South Africa; there are personal references, mainly to the work of South African investigators and to the Herbert medallists of 1939, among whom is Dr. J. Hutchinson. There are also several short papers of scientific interest, but the outstanding contribution of the volume is to the science of taxonomy.

"A Review of the Genus Cyrtanthus" by Dr. R. A. Dyer contains detailed descriptions of forty-four species in the genus which occur in the eastern and southern regions of South Africa. Three species are described for the first time, namely, *C. falcatus*, *C. attenuatus* and *C. bicolor*. Dr. H. P. Traub and J. C. Th. Uphof have also made a further revision of the genus Amaryllis, and publish a key to the species, of which seventy-seven are now recognized. Other new species described in the volume are *Amaryllis Kromerii*, *Zephyranthes insularum* and *Z. Plumierii*, the two last-mentioned being described by H. Harold Hume from the West Indies. A cytological confirmation of taxonomy in the genus Cooperia is furnished by Walter S. Flory, who shows by means of chromosome counts that the recently discovered *C. Traubii* is distinct from the earlier *C. Drummondii* and *C. pedunculata*. A useful correlation between rainfall and the distribution of Amaryllids is drawn by Frances M. Leighton, who shows that these plants prefer the moister parts of South Africa, with equal distribution of the rainfall between summer and winter. They will, nevertheless, grow in quite arid regions, but in dry summers the plants lose their leaves before flowering.

Infra-Red Drying

IN the spectrum the radiations which have a wavelength greater than 7600 A. include those that produce a maximum sensation of heat. The *Electrical World* of New York gives an important practical application of this scientific fact which has effected appreciable economies in drying the paint of letters made for advertising signs, which in many cases have to withstand rough usage. In a test the average time of air-drying took about twelve hours, occupying valuable space and giving time for dust to collect on the surface of the product and so spoiling its finished appearance. With the new arrangements, the sprayed letters are placed on an endless chain, travelling in one direction on the upper level and in the other on the lower level before being dumped into a bin. During this period, which lasts only 7½ minutes, the letters are exposed to the rays from twenty-four 250-watt infra-red lamps staggered at 10-in. centres. An earlier use of infra-red rays was made at Ford's works in Ohio. This method has apparently been successful; and if suitably modified would be useful in other practical applications.

Accidental Deaths in Old Age

ACCORDING to an editorial in the September issue of the *Statistical Bulletin*, issued by the Metropolitan Life Insurance Company of New York, the 7,500,000 persons of 65 years and more form only 6 per cent of the total population of the United States, but fully a quarter of the annual fatal accidents in that country occur in persons of that age. This excessive mortality is found both in men and women, but is relatively higher in women. Falls are by far the most frequent causes of fatal accidents in old people, and account for about 15,000 such deaths annually in the United States. The commonest types are falls on floors, stairs and in the street, and relatively few deaths are due to falls from high places. Motors cause the death of about 5,500 old persons, about two thirds of the deaths being due to accidents in which vehicles strike pedestrians. Accidental burns (apart from conflagrations) account for 1,100 deaths every year at this age, a large number of the deaths being caused by clothing catching fire at stoves and grates. Deaths from illuminating gas poisoning are frequent in elderly persons, probably because they do not detect the smell of escaping gas so well as younger persons, and are less likely to recover from carbon monoxide poisoning. The writer expresses the hope that the education of youth to-day in safe ways of living will be of value not only at the present time but will also benefit the aged of the future.

The Imperial Cancer Research Fund

THE thirty-seventh annual report (1938–40) of the Imperial Cancer Research Fund was presented to the annual meeting of the Governors on April 17. Prof. H. R. Dean, Prof. H. W. Florey, Prof. C. A. Lovatt Evans, and Prof. J. Beattie have been appointed members of the council. Mr. Hugh Lett gave a brief historical account of the work of the Fund since its foundation. Two events of importance to the Fund have occurred since the publication of the last report: a royal charter of incorporation was granted on August 29, 1939, and the new laboratories at Mill Hill were opened on June 27 of the same year. The director, Dr. W. E. Gye, summarizes in the report the researches that have been conducted in the Fund's laboratories. These include work by Dr. R. J. Ludford on the comparative reactions of normal and malignant cells in tissue culture to some chemotherapeutic compounds. A Polish State scholar, Dr. Dmochowski, has investigated antigenic differences between normal and malignant cells. His results demonstrate that there is a fundamental difference between transplanted tumours and spontaneous tumours that may arise in an animal. In the former the malignant cells are introduced and are 'foreign' to the animal, and give rise to reactions which are absent in animals bearing spontaneous tumours, in which the tumour cells are part of the animal's body and are not 'foreign'.

The South-West Essex Technical College

DR. LOWERY, principal of the South-West Essex Technical College and School of Art, has presented to the Governors the first annual report, for the session 1938–39. The College replaces former technical institutes at Leyton and Walthamstow, together with a commercial school for girls at the same place and a school of art at Leyton, and embodies a comprehensive scheme for the development of technical education in the county. When the Principal took over duty in April 1938, the buildings were far from complete and the workshops and laboratories only outlined. These handicaps were well overcome; besides the teaching staffs transferred, many new heads of departments and lecturers were appointed; and at present the full-time staff numbers 82 with 180 part-time instructors. The number of students for the session reached 6,842. Association with the four institutes mentioned and various junior schools has been achieved without a hitch.

We notice a general building course, three foreign language clubs which have run successfully on self-governing lines, and classes on milk technology, bee-keeping and glass-blowing. Biology on Saturday mornings has attracted local teachers, who have maintained a high standard of work and steady attendance. The success of the College and the demands for its teaching are a credit to all concerned. It may well be a model for a substantial advance in education elsewhere.

Progress in Education

EDUCATION in the United States is well served by several periodicals. The issue for February last of *School Life*, the official organ of the U.S. Office of Education, is well illustrated and full of live discussion of controversial issues, while it illustrates the enterprise of educational authorities. The science department of Dover High School in Ohio has leased twenty-five acres of potential flood land which are to be used as a field laboratory for the study of ecology and the management of streams and ponds. It is suggested that the Decennial Census, which is due in April, might be discussed in schools, as it has a very wide scope and will include housing for the first time. *School and Society*, February 17, begins with a good article on "The Teacher Pupil Relationship in a Democracy" and ends with a striking one on "Vocabulary and Success in College". Vocabulary and style are, in fact, of great importance for success in life. Max Müller was not well informed when he put down the words used in a country parish as less than 300; but the rustic world, which has its own expert information to give, is still hampered by its incoherence, and education should be always enlarging the effective use of language. On the elementary side, it is to cost Great Britain, according to the latest yearly estimate, well over 36 million sterling. Forty years since, men of science were below the educated standard in books and journalism; now they are distinguished for good writing, which is appreciated by the general public. This is particularly needed in science, since discoveries are exaggerated and misstated by fluent 'stunt' writers who popularize without adequate knowledge.

Announcements

DR. W. SUCKSMITH, lecturer in physics in the University of Bristol, has been appointed to the chair of physics in the University of Sheffield, in succession to Prof. S. R. Milner, who is retiring at the end of the present session.

THE following appointments and promotions in the Colonial Service have recently been made: D. C. Edwards, agricultural officer, senior agricultural officer, Kenya; E. T. Holmes, senior agricultural officer, Nigeria, senior agricultural officer, Sierra Leone; G. W. Nye, senior botanist, deputy director of agriculture, Uganda; A. H. W. Weir, conservator of forests, deputy chief conservator of forests, Nigeria.

IN commemoration of the centenary of the foundation of King's College Hospital a tablet was unveiled on April 17 at Strand House, Portugal Street, London, which showed the site occupied by the hospital from 1839 until 1913.

THE Rockefeller Foundation has made a grant of some £200,000 to Prof. E. O. Lawrence for the construction at the University of California of a cyclotron of 184 in. diameter. The total weight of this apparatus will be about 5,000 tons and it will take about three years to build. Such a machine is expected to produce deuterons of 10^8 volts energy.

DR. PHILIP E. SMITH, professor of anatomy at the College of Physicians and Surgeons, Columbia University, was elected president of the American Association of Anatomists at the fifty-sixth annual convention held at Louisville, Kentucky, on March 21.

To encourage the preparation of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual award of a medal, together with a prize consisting of books and/or instruments to the value of £5. A copy of the rules governing the award can be obtained from the Secretary, Institute of Fuel, 30 Bramham Gardens, London, S.W.5.

THE Egypt Exploration Society, of 2 Hinde Street, Manchester Square, London, W.1, and 1450 Broadway, New York, announces that on September 1 it will publish in two volumes "Temples of Armant" by Sir Robert Mond and Oliver H. Myers. Lady Mond has generously made it possible to finish the work of the Mond Expedition in the manner originally contemplated, and the last three years work is being published in two memoirs, "Temples of Armant, a Preliminary Survey", and "Cemeteries of Armant II and a Saharan Culture". Each work will be published in two volumes, one of text and one of plates (some of which will be coloured), in the same style as "Cemeteries of Armant I".

REFERENCE was made in NATURE of May 4, p. 701, to the amalgamation under the style of Newton and Co., Ltd., of two well-known firms of the name of Newton. It should have been stated that the combined business is now being carried on at 72 Wigmore Street, London, W.1.

ERRATUM.—In the letter entitled "Rhythmical Impedance Changes in the Trout's Egg" in NATURE, May 11, p. 744, line 11, for "sodium nitride" read "sodium azide".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

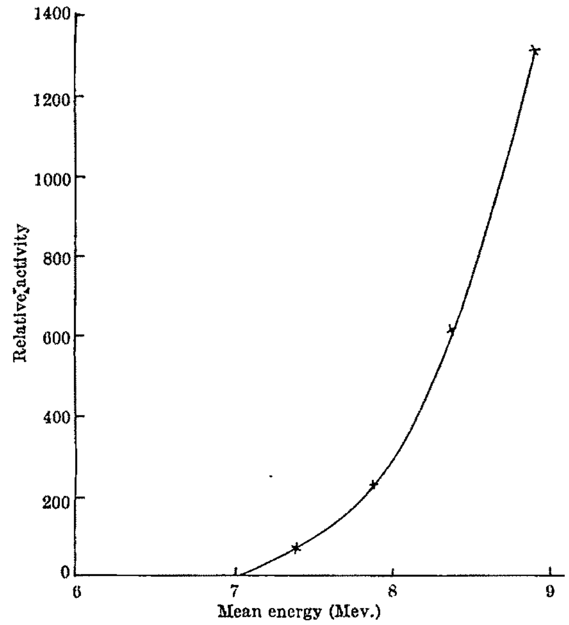
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 784. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of Disintegration Produced by Deuterons

IN a previous communication from this laboratory, Krishnan and Gant[1] reported the formation of ^{106}Ag when silver was bombarded with 9 Mev. deuterons. It appears that this reaction can only be explained by

$$^{107}\text{Ag}\ (d - d, n) \text{ or } (d - p, 2n)\ ^{106}\text{Ag}.$$

Since it is well known that ^{62}Cu can be produced by certain methods which also yield ^{106}Ag (namely, $n - 2n$, $\gamma - n$), it was therefore considered that deuteron bombardment of copper might also produce ^{62}Cu. We have bombarded pure copper foil with a few microampere-minutes of 9 Mev. deuterons from the Cavendish cyclotron. The copper fraction was chemically separated from the bombarded sample and its positron activity was examined with a Geiger-Müller counter (the magnetic field used to resolve the positrons being adjusted so that the positrons from ^{64}Cu were excluded). A single positron activity of energy more than 2 Mev. with a half-life of 10·5 minutes was observed. This would appear to be due to the well-known ^{62}Cu[2]. Excitation function measurements were made by exposing a pile of copper foils (11·4 mgm./sq. cm.) to the deuteron beam and then measuring the activities after chemical separation as above. The accompanying energy-yield curve was obtained.



The threshold for the production of this radio-element seems to be at about 7 Mev. The nature of the curve clearly indicates that the effect cannot be due to the neutron or γ-ray background, and it would seem to explain why the effect was not observed earlier, in that previous experimenters did not use deuterons of more than 8 Mev. energy.

Further experiments were made in an attempt to decide whether the reaction was $(d - d, n)$ or $(d - p, 2n)$. If the latter alternative be correct, the $(d - p)$ reaction should be observed to decrease as the $(d - p, 2n)$ reaction increases, these two being opposing reactions. The excitation function for the formation of ^{64}Cu (12·8 hr.) by deuteron bombardment of copper $[(d - p)$ reaction] was measured (this was first done by A. G. Ward in this laboratory and later confirmed by us), and it was observed that the yield from this reaction decreased above 8 Mev. This result would seem to show that in the formation of ^{62}Cu the $(d - p, 2n)$ reaction is more probable than the $(d - d, n)$ reaction.

R. S. KRISHNAN.
T. E. BANKS.

Cavendish Laboratory,
Cambridge.
April 10.

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[1] Krishnan and Gant, NATURE, **144**, 547 (1939).

[2] Livingood and Seaborg, *Rev. Mod. Phys.*, **12**, 30 (1940).

Calculations on the Energies of Hydrocarbons

WE have made a number of calculations on the energies of various hydrocarbons and have also obtained related properties such as the internuclear distances in the ground and simple excited states, the heats of formation and the approximate wave-length of certain absorption bands. Incidentally, an estimate of the heat of sublimation of carbon has been made which is probably as reliable as any other value hitherto given.

The energy of the most stable state of benzene may be written $6H + 6S - 0{\cdot}4J$, while the energy of the nearest excited singlet state is $6H + 6S - 3{\cdot}0J$, where H is the energy of the carbon-hydrogen bond, S and J are functions defined by Lloyd and Penney[1]. The shape of the excited state is found to be regular, with the C–C link about 1·44 A. in length. The experimental value of the 'breathing frequency' in this state is 920 cm.$^{-1}$. The calculated value is a little more than 900 cm.$^{-1}$, the exact value depending on the type of potential function assumed for the double bond and the normal 'benzene' bond (namely, parabolic law, Morse function, etc.). The energy difference between the two states is roughly $2{\cdot}6J$, where J has its value at the normal ring distance, and is therefore 1·85 e.v. Hence the absorption band corresponding to the transition from one state to the other is calculated to be about 39,000 cm.$^{-1}$—almost exactly the observed value. When suitable refinements are made in the theory, the agreement with experiment is still almost exact. This part of our work may be regarded as an extension of a theory of the origin of the absorption bands of benzene proposed by Sklar[2].

Similar calculations on butadiene show that the central C–C link has a length 1·42 A. in the excited state, compared with 1·43 A. in the ground state, and the outer links have lengths 1·61 A., compared with 1·34 A. in the ground state. The energy difference between the two states is 45,000 cm.$^{-1}$, compared with the experimental value 48,000 cm.$^{-1}$. For this molecule, it will be noticed, the internuclear distances in the two states are very different, and as a result, the band in the fluorescent spectrum arising from the transition from one to the other should show considerable vibrational structure.

Calculations on more complicated polyenes have also been made, with results similar to those quoted for butadiene.

The theory employs only the double bond and benzene bond energies and force constants. Now the force constants are known within a few per cent, and in any event their importance in the theory is only subsidiary. Thus the only uncertainty is that arising from the unknown value of the heat of sublimation of carbon, placed by various observers between 130 and 170 kcal./mol. Pauling[3] adopts the latter value. Support for his view may be obtained as follows. Suppose that the heat of sublimation is changed to $(170 - \Delta)$ kcal./mol. Then the calculated value of the energy of the absorption band of benzene mentioned above is decreased roughly by $8\Delta/7$. Thus if $\Delta = 40$, the calculated energy of the band is changed from 111 kcal./mol. to 65 kcal./mol., the observed value being 110. Similarly, the agreement between theory and experiment for butadiene is completely spoiled. We conclude that the heat of sublimation of carbon is 170 kcal./mol., with a possible error of 10 kcal./mol.

Full details will be published later.

G. J. KYNCH.
E. H. LLOYD.
W. G. PENNEY.

Imperial College of Science and Technology,
London, S.W.7.
April 15.

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[1] *Trans. Farad. Soc.*, **35**, 835 (1939).

[2] *J. Chem. Phys.*, **5**, 669 (1937).

[3] *J. Amer. Chem. Soc.*, **54**, 3570 (1932).

Structure of the OD Bands of Heavy Water

BANDS due to the OD molecule have been photographed with a large quartz Littrow and a 10-ft. concave grating spectrograph by using discharges through vapour of heavy water of a high degree (99·6 per cent) of purity. The bands at λ2872 and λ2916 have been measured. They correspond to the (1, 0) and (2, 1) bands of OH with heads at λ2811 and λ2875 due to the electronic transition $^2\Sigma^+ \rightarrow {}^2\pi_{\text{inv}}$. With the aid of the rotational differences derived from the six main *P*, *Q* and *R* branches the mean values of the constants for the band λ2872 are found to be (in cm.$^{-1}$) as follow:

$$B'_v = 8{\cdot}736 \quad ; \quad D'_v = 0{\cdot}548 \times 10^{-3}$$
$$B''_v = 9{\cdot}870 \quad ; \quad D''_v = 0{\cdot}420 \times 10^{-3}$$

The values B'_v and B'' are in good agreement with those calculated from the corresponding constants of the OH molecule using the mass ratio, $P^2 = 0{\cdot}5301$ (^{1}H = 1·0081 and ^{2}H = 2·0142) for the two isotopic molecules OH and OD. The wave numbers of R_1 (1) and Q_1 (1) are 34796·9 and 34761·6 cm.$^{-1}$ respectively.

Full details of the structure will be published elsewhere.

K. R. RAO.
M. G. SASTRY.

Andhra University,
Waltair.
March 14.

The Generalized Kaleidoscope

PROF. H. S. M. COXETER, in his recent admirable essay[1] on polyhedra, has brought the generalized kaleidoscope to the notice of a wider public. In the accounts of this apparatus which I have seen, there is no reference to those cases in which the angle between two of the mirrors is 120°. The trihedral examples, though interesting, are perhaps of less importance than the case described below.

It is said to have been proved that a kaleidoscope cannot have more than six mirrors; it is, however, possible to have one with eight arranged in a manner suggested by the faces of the rhombic dodecahedron. Take four mirrors the shape of congruent isosceles triangles with the angle at the vertex equal to 70° 32′, and arrange them so that they form the slant faces of a pyramid on a square base. (The images of a point-object at the centre of the base, including the object itself, form the vertices of an octahedron). Taking another set of four mirrors, arranged as before, and bringing the two sets together base to base, an octahedron of mirrors is obtained, the dihedral angles of which are 120° and 90°. The images of a point-object inside it, together with the object itself, form the vertices of a solid tessellation of cuboctahedra and octahedra.

SIDNEY MELMORE.

Winkinghurst,
Carr Lane,
Acomb, York.
April 9.

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[1] Ball, W. W. R., "Math. Recreations and Essays" (1939), chapter v.

Carbohydrate Metabolism of Tumours

RECENT correspondence by Drs. Boyland and Dickens in NATURE has raised once again the question of the existence of an abnormal carbohydrate metabolism of tumours.

Dr. Dickens[1] maintains that, whilst neither aerobic glycolysis alone nor in combination with a low respiratory quotient is "in the strictest sense specific for tumours, . . . nevertheless, the association in tumour metabolism of relatively high aerobic and anaerobic glycolysis with the lowered respiratory quotient is such a constant one that to dismiss it is to discard as unimportant the most characteristic of established biochemical peculiarities of tumour tissue". We agree with Dr. Dickens that this type of metabolism is very common in tumours, but whereas Dr. Dickens (whose opinion on this matter is still shared by many other workers) considers it as the most characteristic of established biochemical peculiarities of tumour tissue, we feel that such features of carbohydrate metabolism, as stressed by Warburg, Dickens and others, are in no sense peculiar to tumour growth, and have no significance in the elucidation of the tumour problem.

In his communication to NATURE, Dr. Dickens brings forward the following arguments in support of his case: (*a*) Practically all tumours have a strong aerobic glycolysis and a low respiratory quotient; (*b*) normal tissues, with few exceptions, do not possess this type of metabolism; (*c*) in the experimental production of hepatomata, the liver cells acquire the type of metabolic activity characteristic of malignant tissue; and (*d*) when muscle is replaced by malignant sarcoma, a great increase of glycolysis occurs.

These arguments would seem untenable on the following grounds:

The tumours, the metabolism of which has so far been investigated, are derived from tissues which *normally* glycolyse aerobically (for example, from skin and intestinal epithelium and fibroblasts). On the other hand, a number of spontaneous tumours have been found to be entirely free from aerobic glycolysis[2].

With regard to the metabolism of normal tissues, to say that, with few exceptions, they do not possess this type of metabolism, is erroneous. On the contrary, as Boyland points out[3], ". . . most body tissues (with some exceptions such as kidney cortex, spleen, ovary and lung) which have been carefully examined appear to have some aerobic glycolysis". Indeed, several normal tissues glycolyse more strongly than many malignant tumours. The argument that the aerobic glycolysis of certain normal tissues is due to a hypothetical 'damage' resulting from the use of an unsuitable medium has been disproved in the case of kidney medulla by Dickens himself (in collaboration with Weil-Malherbe[4]). In the case of fibroblasts in tissue culture, the argument is all the more unreasonable, since the metabolic values are obtained under conditions which are probably far more physiological than with the accepted slice technique. To consider all non-glycolysing normal tissues and glycolysing tumours as the rule, and all glycolysing normal tissues and non-glycolysing tumours as exceptions, is clearly unreasonable.

The citation as evidence of the metabolism of hepatomata is of doubtful value, since normal liver itself glycolyses both aerobically and anaerobically to a variable extent, depending on the state of nutrition of the organ. In a hepatoma, the aerobic glycolysis may be several times that of the average values of normal liver[5], but hepatomata with little or no aerobic glycolysis have also been reported[6]. In any event, many investigators (including Dr. Dickens) have long since abandoned the idea that aerobic glycolysis is, in itself, peculiar to tumours. According to the current theory, it is only aerobic glycolysis together with a low respiratory quotient which is taken as a metabolic defect characteristic of tumour growth. So far as we know, no one has yet measured the respiratory quotient of hepatomata, and it is difficult to see what significance can be expected from such measurements, since *normal* liver is known to have a low respiratory quotient[7].

Finally, as regards the great increase in glycolysis when "muscle is replaced by malignant sarcoma", this is the most misleading argument of all, since the sarcoma in question (Rous I) is of connective tissue origin (macrophage[8] or fibroblast[9]), and is not derived from the muscle "which it replaces".

Most investigators who consider aerobic glycolysis in combination with a low respiratory quotient as significant features of tumour metabolism, base their arguments (1) on a comparison between the metabolism of tumours derived from skin or intestinal epithelium or connective tissue with such normal tissues as pancreas, liver, spleen, testis, etc., instead of with the normal tissues from which these tumours happen to be derived, and (2) on the hypothetical assumption that the glycolysis of most normal tissues is due to an artificially induced damage.

In an attempt to avoid both these sources of error, we have carried out a comparative study of the metabolism of normal rabbit skin epithelium (a tissue evidently resistant to damage) and the Shope papilloma derived from it. We found[10,11] that the values for respiration, aerobic and anaerobic glycolysis and respiratory quotient for the two were almost identical, and similar to many of the values for skin carcinoma quoted in the literature.

From these observations and from the work recorded in the literature on the glycolysis of normal mucous membrane and fibroblasts, we draw the conclusion that, *when a tumour is compared with the tissue from which it is derived*, there are no characteristic differences or peculiarities between the carbohydrate metabolism of the two.

I. BERENBLUM.
E. CHAIN.
N. G. HEATLEY.

Oxford University Research Centre of
the British Empire Cancer Campaign,
Sir William Dunn School of Pathology,
University of Oxford.
April 19.

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WE agree with Berenblum, Chain and Heatley, and with Boyland[1], that high aerobic and anaerobic glycolysis and low respiratory quotient, while very common properties of tumour tissue, are not specific. In fact, we have in hand additional work to be published soon which shows that intestinal mucosa[2] possesses very active aerobic and anaerobic glycolysis combined with a low respiratory quotient.

On the other hand, these authors maintain that the tumours so far studied which have high aerobic glycolysis and low respiratory quotient have arisen from normal tissue which itself has this type of metabolism. The present evidence for and against this view does not seem to us conclusive. Only two examples are yet known in which such a strict comparison is possible; for in our opinion the value for this purpose of measurements on cultured tissue-cells, growing under conditions which are certainly unphysiological, is very doubtful.

The first example is the hepatoma, to which Berenblum *et al.* take exception on the grounds that aerobic glycolysis may sometimes be lacking in hepatomata, and that normal liver has variable and often considerable aerobic glycolysis. Both in our own experience, however, and in the recorded values, we have always found the aerobic glycolysis of liver to be small compared with its respiration, especially when it is remembered that the often large formation of acetone bodies by this tissue must be taken into account. The second example is the transformation of skin epithelium into Shope papilloma, studied by Berenblum, Chain and Heatley[3]. Some experimental data are not detailed in this paper, such as the medium used, the number of observations and the consistency of the results; also it is not stated if normal tissues give the same values of aerobic glycolysis and respiratory quotient in the minute pieces used as they do in the usual larger-scale experiments. The purity of the papilloma tissue used for comparison with 100 per cent pure epithelium and the stage of malignancy arrived at are also desirable data. However, in the one example given, there was no change of metabolism other than a slight general lowering of all the figures, including respiratory quotient, when a tumour had resulted.

In our opinion, these two cases counterbalance one another, and no general conclusion can as yet be drawn as to the occurrence of an alteration of metabolism in the development of cancer.

F. Dickens.
H. Weil-Malherbe.

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Newcastle-upon-Tyne.
April 22.

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Chemical Estimation of Vitamin B_6 in Foods by Means of the Diazo Reaction and the Phenol Reagent

The recent investigations of Kuhn and his co-workers[1] and Harris and Folkers[2] have shown that vitamin B_6 is 2-methyl-3 hydroxy-4 : 5 di(hydroxy-methyl)-pyridine. It contains a hydroxy group in the β-position of the pyridine ring, which gives the characteristic red coloration of true aromatic phenols with ferric chloride. The vitamin also gives colour reactions with diazotized aromatic amines and the phenol reagent of Folin and Ciocalteu[3].

A method has been developed for the estimation of the vitamin in biological materials using diazotized sulphanilic acid or the phenol reagent. Since these reagents are not specific for vitamin B_6, it is necessary to remove all interfering substances before colorimetric estimations can be carried out. By the procedure outlined below it has been found possible to obtain values for the vitamin B_6 content of various foods which appear to correspond approximately to those obtained by other workers using biological methods

A suitable quantity (2–50 gm. containing 10–20 rat units of vitamin B_6[4]) of the finely minced or powdered test material was digested with pepsin for twenty-four hours. Protein and its derivatives were removed by tungstic acid. Purine, pyrimidine and imidazole bases were precipitated with silver nitrate and barium hydroxide and the excess silver removed. The solution was adjusted to pH 1–2 and the vitamin B_6 present was adsorbed on clarite (2 gm.). The vitamin was eluted from the clarite with hot barium hydroxide and the silver precipitation was repeated. The solution was then adjusted to pH 6, concentrated to 25 ml., and treated with sodium nitrite and acetic acid for 15 minutes to destroy any amino group that might be present. After bringing the pH to 7, the solution was filtered and made up to 50 ml. 10 ml. aliquots were treated with diazotized sulphanilic acid and the azo colour formed estimated colorimetrically by comparison against a standard of 20 μgm. of pure vitamin B_6 treated in the same way. The method is highly sensitive. 10 μgm. of vitamin B_6 is easily estimated and the colour obtained is proportional in intensity to the amount of vitamin present. The values for fifteen foodstuffs are given in the accompanying table.

VITAMIN B_6 CONTENT OF VARIOUS FOODSTUFFS

Foodstuff	*Vitamin B* *μgm./gm.*
Yeast, dried (brewer's)	54·0
Yeast, dried (brewer's) (autoclaved at pH 9·4)	53·0
Rice polishings	13·4
Liver, sheep	13·4
Muscle, sheep	4·5
Milk, cow's	1·7
Maize, yellow, whole	7·1
Wheat, whole	7·6
Cholam (*Sorghum vulgare*)	8·0
Rice, husked	6·6
Rice, highly milled, raw	3·0
Soya bean	8·0
Beetroot	1·3
Cabbage	3·1
Plantain, ripe	1·3

Known amounts of vitamin B_6 were added to weighed quantities of foodstuffs and the recovery was good in all cases, ranging from 70 to 100 per cent

The method described is applicable to all types of foodstuffs. It is probable that in some cases it may be abbreviated. For example, treatment with nitrous acid has been found to be unnecessary in the case of yeast. Possibly the second silver precipitation is not always necessary A variety of different phenolic reagents may be used and many modifications in detail are possible. For example, with yeast and potatoes comparable values have been obtained using diazotized sulphanilic acid and p-nitroaniline and the phenol reagent, nitrous acid treatment being omitted.

A fuller account of these investigations will be published in the *Indian Journal of Medical Research*

M. Swaminathan.

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Indian Research Fund Association,
Coonoor, S. India.
March 27.

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Liberation of Potassium from Muscle by Acetylcholine and Muscle Contraction and its Absence after Adrenalectomy

Cicardo and Moglia recently announced in Nature[1] that, after injecting acetylcholine into the sciatic artery of a toad, "the contracture of the muscles is accompanied by an increase in the concentration of potassium in the liquid flowing from the vein".

In a paper presented to the Swiss Physiological Society on January 27[2], we announced a similar result in four normal cats. An injection of 5–40 acetylcholine was made into the femoral artery towards the muscle, and all the venous blood coming from the leg muscles was collected.

There was a great increase of plasma potassium, from 15 mgm. per cent without injection of acetylcholine, to 25 mgm. per cent or more after the injection. The liberation of potassium ceased a few seconds after the injection. The total quantity of potassium liberated was about 0·5 mgm., most of which came from the gastrocnemius muscle.

In confirmation of numerous previous experiments, we were also able to show, on the same preparation, that the plasma potassium is also raised during contraction of the gastrocnemius caused by electrical stimulation of the sciatic nerve.

In nineteen experiments on twelve cats, the plasma potassium increased from 16·1 mgm. per cent to 28·2 mgm. per cent. The gastrocnemius (weighing about 30 gm.) liberated about 1·5 mgm. of potassium during 4,000 gm. cm. work per minute. This reaction also ceased immediately after the end of the contraction, while lactic acid production continued for some minutes.

We were especially interested, in these experiments, in their bearing on the question of muscle metabolism after adrenalectomy.

As we have shown in previous experiments[3], there is a close connexion between carbohydrate and potassium metabolism which is disturbed after adrenalectomy. We therefore repeated the above experiments on adrenalectomized cats, and were able to show that after injection of acetylcholine into the muscle artery, no potassium whatever was liberated (nine experiments on four cats).

Similarly, after electrical stimulation of the sciatic nerve, the plasma from the muscles of adrenalectomized cats showed no (or only a minimal) increase of potassium (eleven experiments on five cats).

The plasma potassium of these animals, on the second to fifth day after the second adrenalectomy, was raised as usual, but did not change after stimulation. The total quantity of potassium liberated for 4000 gm. cm. work per minute was only 0·2 mgm., which is an almost negligible quantity.

Since potassium plays a part in carbohydrate metabolism, we believe that these changes in plasma potassium are connected with the absence of glycogen re-synthesis after adrenalectomy.

The detailed report of these experiments will be published later.

F. Verzár.
J. C. Somogyi.

Physiological Institute,
University of Basle.
April 10.

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Function of Chlorocruorin in Sabella and of Hæmoglobin in Lumbricus

A number of invertebrate animals possess blood pigments which are generally assumed to be respiratory, although only in a few instances has a respiratory function been demonstrated experimentally. One or more of three functions are imputed to these pigments: (*a*) they may act like hæmoglobin in ourselves, as a transporter of oxygen at all times; (*b*) they may come into action as oxygen transporters only when oxygen is deficient in the outside world, there normally being enough of the gas in simple solution in the blood for the restricted wants of the relatively sluggish animal; (*c*) they may serve as a reservoir of oxygen to be drawn upon during temporary shortage of the gas in the environment.

Among the invertebrates, function (*a*) has hitherto been demonstrated only in a single case, namely, in Tubifex. When the hæmoglobin of this freshwater oligochæte worm is put out of action with carbon monoxide, the animal consumes less oxygen at atmospheric and all lower oxygen pressures[1].

Because the hæmoglobin of the polychæte worm Arenicola has a very low loading tension (oxygen pressure for 95 per cent oxyhæmoglobin)[2] and can therefore take up oxygen from water in which the pressure of the gas is low, function (*b*) has been suggested for it[3]. But this suggestion lacks experimental proof, and if the oxygen pressure in the respiring tissues were close to zero, the oxyhæmoglobin, in spite of its low unloading tension (oxygen pressure for 50 per cent oxyhæmoglobin), would still give up its oxygen to these tissues even when the worms are in air-saturated water. Experimental evidence has, however, been adduced that function (*b*) is exhibited by the hæmoglobin in the blood of the earthworm[4,5], but work on Lumbricus now completed in this laboratory by Dr. M. L. Johnson has proved that this is not so and that the blood pigment of the earthworm has function (*a*) in a modified form. When the earthworm's hæmoglobin has combined with carbon monoxide the animal consumes less oxygen, both at normal atmospheric and at lower oxygen pressures, although the greatest use of the hæmoglobin is made at oxygen pressures about half atmospheric.

As regards function (*c*), the amount of oxygen in the blood of Arenicola is sufficient to last the animal about an hour; it could therefore help to supply the animal's needs while buried in mud at low tide and then presumably unable to obtain fresh supplies of oxygen[2,3]. When in its mud tube under water, the ventilation movements of Arenicola are intermittent, and its hæmoglobin may act as a temporary oxygen store between successive ventilation periods[6]. In the gephyrean worm Urechis, the amount of oxygen combined with hæmoglobin is also sufficient to last the animal for about an hour, and is thought to act as a store both between ventilation periods and at low tide[7]. This assumed function of Arenicola and Urechis hæmoglobin lacks proof. Would these animals in their burrows use less oxygen if deprived of their respiratory pigment?

Chlorocruorin is a unique chemical relative of hæmoglobin, present only in the blood of a few kinds of marine worms[8]. Work in this laboratory recently concluded by Mrs. R. F. Ewer has shown that the chlorocruorin of Sabella exhibits function (*a*). Like earthworms, frogs and certain fishes[9], and unlike human beings, Sabella can be gassed with carbon monoxide and yet not be killed. In these circumstances chlorocruorin cannot combine with oxygen, and the gassed animals were found to consume less oxygen both at atmospheric and at lower pressures of oxygen in the environment. It is clear, then, that the function of chlorocruorin is to cover a certain proportion of the worm's oxygen consumption. That oxychlorocruorin would part with its oxygen to the animals' tissues, even when the worm is in well aerated water, could be foreseen from two circumstances: (1) the unloading tension of chlorocruorin is relatively high[8], and (2) we found that the oxygen consumption of Sabella declines soon after the oxygen pressure in the water decreases, so that the oxygen pressure in the tissues is presumably very low[10].

Carbon monoxide inhibits intracellular oxidase. Although the relative pressures of carbon monoxide and oxygen in our work on Sabella and Lumbricus made it very improbable that this had happened, it was made certain by further measurements of the oxygen uptake of tissue slices with and without carbon monoxide; they were not significantly different.

This work will be published in the *Proceedings of the Royal Society*.

H. MUNRO FOX.

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University of Birmingham.
April 9.

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Bilirubin in Urine

MANY chemical tests for bilirubin in urine have been described, none very satisfactory and none very sensitive. In blood, bilirubin is estimated quantitatively and qualitatively by the well-known method of van den Bergh, which will indicate accurately quantities diluted to one in a million; and Fouchet's reagent, which is sensitive, in the same circumstances, at the dilution of one in sixty thousand.

Hitherto, the van den Bergh test has not been applicable to urine without complicated preliminary manipulations. I have found a very simple manœuvre which enables the van den Bergh or Fouchet test to be applied to any specimen of urine with results that are reliable, sensitive and accurate. The method consists in the addition of ten per cent very finely powdered dried normal egg albumen to an aliquot portion of the urine under test; the mixture must be very well shaken until the powder has all been taken up. The van den Bergh and Fouchet tests can then be conducted with the albumized urine exactly as with blood serum, and with results comparable in sensitivity.

The method will be described in full later.

This new test has obvious application in cases of intravascular hæmolysis after blood transfusion, in cases of malaria, blackwater fever, Weil's disease, yellow fever, etc.

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March 30.

Mycorrhizal Habit in the Date Palm (*Phoenix dactylifera* Linn.)

THE date palm grows in Egypt in a great variety of soils and conditions. I have seen palms even growing on the seashore of the Gulf of Suez in places which are occasionally flooded with sea-water and where the *p*H of the soil ranges from 8 to 9. It was thought worth while to test the presence or absence of mycorrhiza in such a widely distributed plant.

In the preliminary tests carried out about two years ago, it was found rather difficult to get satisfactory material from old palms owing to the nature of root growth. However, I started to raise plants from seeds and examine their roots at intervals. It has been found that roots of seedlings up to eight months old and grown in the sandy garden of the Faculty of Science, Abbasieh, are free from mycorrhizal association. At such a stage marked swellings are recognized at the tips of some roots, and on their examination they have been found to contain no fungus. Nevertheless, in plants fifteen months old and grown in pots containing Nile silt, the mycorrhizal association is quite visible.

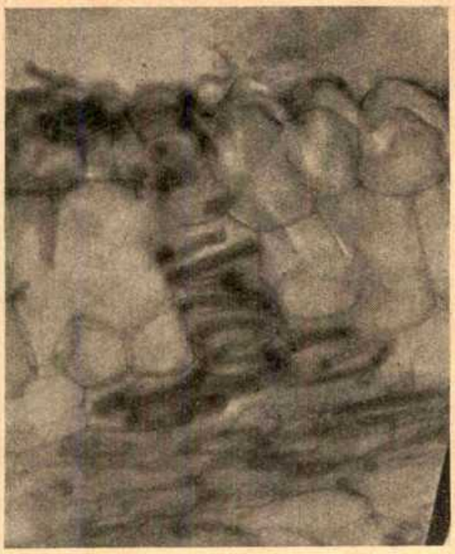

Fig. 1.
INVADING HYPHA WITH THE CHARACTERISTIC SPIRAL COILS.

Infected roots become hypertrophied, relatively more thickened and more opaque than the non-infected. They sometimes simulate coralloid roots.

The association is of the vesicular-arbuscular type. The extramatrical mycelium is easily observed and is of usual type. Root hairs are absent. The invading hypha forms a sort of appressorium before penetration. It is sometimes developed between the epidermal cells and it is also found directly opposite their outer walls. After invasion of the thick outer cellulose wall, the fungus proceeds through the cell cavity. It then develops in a very characteristic spiral fashion through a radial row of cortical cells 3–4 layers deep. After that it spreads laterally and inwardly for 3–4 layers producing these spirally coiled hyphæ within the cells. Then it ramifies in the cortex, producing intra- and inter-cellular mycelia and developing vesicles and arbuscules. Vesicles differ in shape and size and they may be inside the cells or between them. Arbuscules chiefly develop in the mid-cortex and in the deeply seated layers. In good material the whole of the cortical cells and the intercellular spaces, with the exception of the outermost 4–6 layers and the two layers next to the endodermis, are seen to be packed with the fungus.

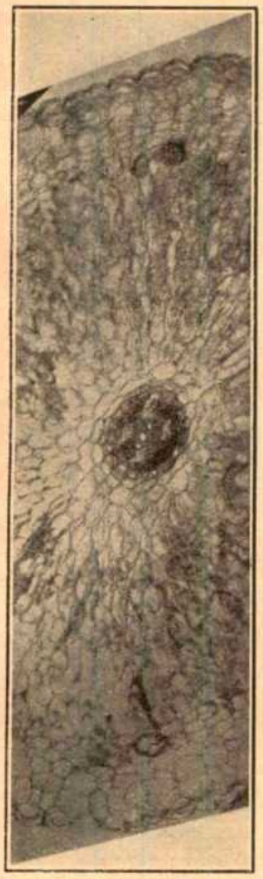

Fig. 2.

TRANSVERSE SECTION OF INFECTED ROOT SHOWING DISTRIBUTION OF THE FUNGUS. IN THE TOP PART SPIRALS AND VESICLES ARE SHOWN.

Cultivation of the fungus and its cytological characters are under investigation.

Younis Sabet.

Botany Department,
Faculty of Science,
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March 20.

Blind Seed Disease of Ryegrass

It is now known that the blind seed disease of ryegrass, associated with low germination, has been present in Great Britain for at least four years. It appears that the true perennials are particularly susceptible and, as these are the more valuable forms, the disease is of considerable economic importance.

This disease of ryegrass was described in New Zealand by Hyde[1,2] and by Neill and Hyde[3]. The causal fungus was associated by these writers with the genus Pullularia, although it does not exhibit spore budding characteristic of that genus. When work was begun on this disease in Britain, a Pullularia form was isolated from seeds which were infected by the blind seed fungus[4] and, as at that time the paper by Neill and Hyde[3] was not available, the two fungi were not clearly distinguished. They are, under certain cultural conditions, very similar and therefore, in view of the original description of the blind seed disease as the 'Pullularia disease', it is desirable to record that, in Britain, the blind seed fungus as well as Pullularia sp. are often present on one and the same ryegrass seed. The exact identity, relative pathogenicity and frequency of occurrence of these fungi are under investigation.

Malcolm Wilson.
M. Noble.
E. G. Gray.

Department of Mycology,
University of Edinburgh.
April 23.

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Humpback Whales off West Australia

I notice in Nature of December 16, 1939, an interesting article by G. W. Rayner on the "Preliminary Results of the Marking of Whales by the Discovery Committee". In this article it is stated that a north and south migration of Humpback whales "along the western coast of Australia has been conjectured for some time past". While I am interested to note that Humpback whales marked in the Antarctic have appeared off the north-west Australian coast, I must criticize the use of the word *conjectured* in the above reference to western Australia.

During the years 1913–15 the movements of the whales on this coast were very carefully watched by the Norwegian whalers, and I had an opportunity on several occasions not only of observing this migration at different points, but also I had access to log books which indicated fairly clearly the times of appearance of the whales and the direction of migration.

The whaling season off the coast of north-west Australia is very definitely limited by the restriction in the time of occurrence of the breeding humpbacks. The dates of their arrival and departure are well known; and in my book "Whalemen Adventurers" (Angus and Robertson, Sydney, 1934) I have given a map to illustrate the direction of the west Australian migration so far as could be judged by the data available. I venture to think that this can scarcely be called a mere conjecture. The *place* whence the northern migrating whales *came* was a matter of conjecture, and here the results of the Discovery marking experiments have established new facts of value.

W. J. Dakin.

Department of Zoology,
University of Sydney.

Prof. Dakin's book "Whalemen Adventurers" and the map therein are well known to me. I am surprised that Prof. Dakin takes such exception to the passage in my article in which I express my view that "a north and south migration [of Humpback whales] along the western coast of Australia has been conjectured for some time past".

In this article the term 'migration' was used only when referring to Humpback whales, for it is only in that species that we have clear evidence, derived from whale-marking, of long-range movements at certain times of the year. Since this evidence is supplemented by the observed movements of Humpback whales off the north-west coast of Australia, we can now speak confidently of a migration along the west Australian coast. I feel that a distinction should be made between 'movements' and 'migrations', and do not consider that the local observations hitherto made fully established a 'migration' along this coast.

In his book, Prof. Dakin does not give very fully the evidence on which he bases his map and the few references to migration in his text. The log book records of which he speaks are for three seasons of very rapidly declining production and for the most part, I imagine, cover only a limited part of the north-west coast of the Australian continent in the vicinity of Norwegian Bay. Prof. Dakin is scarcely justified in extending his conclusions from this neighbourhood to the whole of the west coast, especially as he admits in his letter that the place whence the northward migrating whale came was not known. Whilst Prof. Dakin may have demonstrated the regular movements of Humpback whales off a part of the north-west coast, my remark referred to the west coast, which has a length of about 1,000 miles. For these reasons the word conjectured was used.

I admit our whale-marking data only show, *per se*, that Humpback whales once in the Antarctic may appear later off the north-west Australian coast, but this is a very positive fact and does support much that was previously, of necessity, conjectured.

George Rayner.

"Discovery" Investigations,
c/o British Museum (Natural History),
London, S.W.7.

Points from Foregoing Letters

R. S. Krishnan and T. E. Banks report the formation of ^{62}Cu by deuteron bombardment of copper, as a result of a new type of disintegration, namely, $(d - d, n)$ or $(d - p, 2n)$. The threshold for the production of this radio-element seems to be at about 7 Mev. and the yield increases rapidly between 8 and 9 Mev. Further evidence has been adduced to show that in the formation of ^{62}Cu the $(d - p, 2n)$ reaction is more probable than the $(d - d, n)$ reaction.

G. J. Kynch, E. H. Lloyd and W. G. Penney summarize the results of some new calculations on the energies, internuclear distances and vibration frequencies of the benzene and butadiene molecules. An argument is outlined leading to the conclusion that the heat of sublimation of carbon is 170 kcal./mol.

S. Melmore describes a kaleidoscope of eight mirrors ; it yields a solid tessellation of cuboctahedra and octahedra.

I. Berenblum, E. Chain and N. G. Heatley present evidence from the literature and from their own work to show that the respiration, glycolysis and respiratory quotient of tumour tissue does not differ fundamentally from that of the normal tissues from which the tumours are derived. In reply, F. Dickens and H. Weil-Malherbe consider that in view of the alteration of metabolism accompanying the formation of a hepatoma from normal liver, no general conclusion can as yet be drawn as to the occurrence of an alteration of metabolism in the development of cancer.

A chemical method for the estimation of vitamin B_6 in foodstuffs, using the diazo reaction or the phenol reagent, has been developed by M. Swaminathan.

F. Verzár and J. C. Somogyi show that although potassium is liberated from the muscles of normal cats by acetylcholine, and muscle contraction is stimulated, these phenomena do not occur with adrenalectomized cats. They suggest this is connected with the absence of glycogen re-synthesis after adrenalectomy.

Work by Mrs. R. F. Ewer on the function of the chlorocruorin of Sabella and by Dr. M. L. Johnson on that of the hæmoglobin of the earthworm (Lumbricus) shows that both pigments act as oxygen carriers at and below atmospheric oxygen pressures in the environment, and provide for part of the oxygen consumption of the worms.

Younis Sabet records some observations on the development of the mycorrhizal habit in the date palm. The infected roots become hypertrophied and more thickened. Before penetrating the cell wall, the invading hypha develops an appressorium ; once in the cell cavity it forms a characteristic spiral. Finally, the whole of the cortex (cells and intercellular spores) become packed with fungus.

The fungus which in New Zealand has been described as the cause of blind seed disease of rye grass resembles under certain conditions Pullularia sp. In view of the original description 'Pullularia disease', M. Wilson, M. Noble and E. G. Gray record that Pullularia sp. as well as the blind seed fungus are present. Investigation of these two fungi, as well as of others described on rye grass, is being carried out.

W. J. Dakin queries statements made by G. Rayner in his recent article on whale marking. Rayner states that he distinguishes between 'movement' and 'migration', the latter term only being used when discussing Humpback whales. Dakin's evidence is considered to show movement rather than migration, and his conclusions are thought to lack full confirmation. This has been supplied by the knowledge gained from marking experiments.

RESEARCH ITEMS

Prehistory in Haiti

EXCAVATIONS over a period of three months in 1935, carried out by F. G. Rainey and Irving Rouse, on eleven sites near Ft. Liberté Bay, Haiti, produced some twelve thousand specimens. A report on the excavations is about to be published, but in the meantime the specimens have been examined by the latter in the Peabody Museum with a view of testing the possibilities of a new technique of archæological analysis in elucidating the facts of both space and time relation in prehistory (*Yale Univ. Pub. in Anthropology*, No. 21; 1939). Of the eleven sites (all kitchen midden sites) five were small, consisting of a single deposit on a restricted area, and are termed "camp sites". The remaining six are groups of middens, deep and spread over a broad area, and are termed "village sites". Two phases are distinguished: the Flint Phase, without pottery and apparently food-gathering, and the Shell Phase, with pottery and agricultural. In the second, flint becomes rare and the place of the double-fitted axe is taken by the petalloid celt. From comparative analysis it is suggested that the people of Period I who were responsible for the camp sites migrated from the south-eastern parts of the United States by way of Cuba, being semi-nomadic and living in small groups. In Period II, the region may have been uninhabited. To Period III belong the Macady and Diale sites, settled by a people migrating from South America, possibly in Period II. Presumably, they spoke Arawak and brought agriculture and the petalloid celt, but not pottery. Probably it was the descendants of these people who inhabited the region in Period IV. They adopted the pottery of their Dominican neighbours in place of the local type which had been introduced from North America early in Period III.

The Delinquent as a Type

IN a paper read before the Second Institute of the Washington Child Adjustment Clinic (*J. Crim. Psychopath.*, **1**, 24; 1939) Dr. Ben Karpman, of Washington, D.C., who records four illustrative cases, maintains that there is no such thing as the delinquent as a type or personality, but that there are many persons who may be delinquent, in each of whom the delinquency expresses a different problem. The criminal offences for which they are sent to prison are different, the sentences are different and the crime of each means to each one individually something much more and different than it means to the others. Generally speaking, a delinquent is one whose behaviour is such that society must obviously take measures to defend itself against him, and delinquency refers mainly to petty transgressions as distinct from major crimes such as murder, highway robbery, etc. Transitional cases exist between the juvenile delinquent on one hand and the major criminal on the other who has passed the age of sixteen but has not yet quite entered manhood. Karpman's four cases of juvenile delinquency, whose ages ranged from eleven to fifteen, represent respectively the defective, the psychopathic, the neurotic and psychotic, each of which had a different background and a different crime motivation, though superficially they showed much resemblance to one another.

Substances which Modify Carcinogenic Action

DR. CRABTREE has investigated the effect of substances, which might be considered to inhibit metabolism of tissues, on the production of skin tumours in mice with the carcinogenic 3 : 4-benzpyrene. Certain reactive organic chlorine compounds which check glycolysis delayed the carcinogenic process but never completely inhibited it. The application of naphthoyl nitrile along with 3 : 4-benzpyrene to the skin of mice induced a high incidence of multiple warts. The carcinogenic agent alone usually produced single warts. A preliminary account of this work is given in the thirty-seventh annual report of the Imperial Cancer Research Fund.

Action of Methylcholanthrene on Normal Tissue Cultures

TISSUES from mice of a strain (C_3H), which are known to be particularly sensitive to the action of carcinogenic agents, have been grown in tissue culture in the presence of methylcholanthrene. W. R. Earle and Carl Voegtlin (U.S. Public Health Reports, **55**, 303; 1940) describe the changes which the cultures undergo in response to the carcinogenic agent. The initial effect of the carcinogen is to retard growth, and this is followed by gradual changes throughout each culture. The tissue finally had the appearance of cultures of malignant growths, but on injection into mice they did not produce tumours.

Japanese Anomura

GUSTAV MELIN describes a number of species of Pagurids and Galatheids from the Bonin Islands, Japan ("Paguriden and Galatheiden von Prof. Dr. Sixten Bocks Expedition nach den Bonin-Inseln 1914", *Kungl. Svenska Vitenskapsakademiens Handlingar*, Tredje Serien, 18, No. 2; 1939). There is also included a new species of the Thalassinid Callianidea (*C. planocula*). The descriptions are very carefully made and detailed, with good simple drawings of essential parts. The classification of the Pagurids is discussed at length and revised, and a clear key given for all the genera and sub-genera. Several new species of Eupagurus are described, and the new genus Paguritta established for *Paguritta gracilipes* n.sp. Among the Galatheids there are also new species including *Bathymunida quadratirostrata* from a depth of 70 fathoms, one of the specimens being a female with eggs. There are several species of Petrolisthes, one new, and a new species of Pachycheles. A note at the end of the paper by Prof. Balss states that this valuable addition to our knowledge of the Pagurids and their relatives was completed in 1918–21, but comparison with other work from Japan shows that the new species included have not been described by more recent workers.

Microbiology of the 'Leaf Carpet'

UNDER this term, D. J. Scourfield discusses the microscopic life in the continuous carpet of decaying leaves that forms the characteristic feature of the upper layer, the "mor", of the forest soil. The paper appears in the *Essex Naturalist* (**26**; 1940) and is extremely appropriate to the activities of a natural history society. Mr. Scourfield makes it clear that our information about the characteristic fauna and flora of this leaf carpet is exceedingly scanty, and that a very profitable field lies ready to the investigation of the field naturalist. Knowledge of the organisms characteristic of this position must precede any substantial advance as to the influence this leaf carpet has upon the forest, though it is abundantly clear that the leaf carpet follows quickly upon the closure of the forest canopy and initiates the sequence of changes in the habitat that characterize the establishment of the forest. No fewer than sixteen groups of organisms, present in the leaf carpet, are passed briefly in review. Some of these groups are still little worked out and require, as Mr. Scourfield emphasizes, the collaboration of a number of specialists, but here is a field entirely appropriate to the naturalist and ultimately, probably, of great interest to the forester.

Crossing Experiments with Rusts

THE recent discoveries of the function of the rust spermatia or pycnospores have permitted an active investigation of strains by crossing methods, and Thorvaldur Johnson and Margaret Newton, of the Dominion Laboratory of Plant Pathology, have just reported upon an extensive crossing and selfing experiment with physiological races of oat stem rust (*Canadian J. Res.*, **18**, 54–67, 1940). In crosses the less virulent characteristics are usually dominant, and heterozygous lines, when selfed, tend to produce more virulent strains. Reciprocal crosses suggest that the cytoplasm, as well as the nucleus, contributes to the inheritance of certain pathogenic characters. One great difficulty, of course, is the scarcity of characters the inheritance of which can be studied. In crosses between races of normal (red) and orange uredospore patches the red colour has invariably proved dominant. Selfing studies of one race carried out with teleutospore material of different age give evidence of a marked genetical change in the material brought about in four years, presumably through the ageing of the teleutospores. Normally all infections of this strain produced pycnidia, but in the old material half the infections showed no indications even of rudimentary pycnidia.

Control of Tobacco Mildew

THE downy mildew fungus disease of tobacco is of sporadic occurrence in certain of the United States; but two simple and effective methods of control have been described by P. J. Anderson (Conn. Agr. Exp. Sta. Circular 128, New Haven, Conn.; January 1939). Both methods involve fumigation of the seed bed, and the fumigants recommended are benzol or paradichlorobenzene. Sidewalls and sashes, which normally cover the beds, are made as air-tight as possible. Benzol is evaporated from shallow pans or from wicks placed in suitable vessels; paradichlorobenzene crystals are placed in wire baskets at suitable intervals along the beds. Both methods are curative and not preventive measures, and both offer a useful measure of practical control.

The Permian System

THE original Permian rocks of Murchison occupy a vast structural basin lying west of the Urals and
measuring about 700 miles from w
1,000 miles from north to south.
stratigraphy of this region, of the
the type Permian, and of the correl
series into which it is divisible wit
formations of South China and th
United States is attempted by C. C
Amer. Assoc. Pet. Geol., **24**, 237–28
limestones of the Russian platform,
sidered Upper Carboniferous, are sho
lent to the Artinsk detrital deposits,
ally recognized as Permian. The lo
the Artinsk is found to be not a
graphical horizon, but a contact betw
facies. Although no widely recogni
been demonstrated in the deposits o
the beginning of the Upper Car
Permian time, it has become clear
rapid subsidence of the Uralian geo
great area began with the incursion
schwagerina fauna. This beginnin
synclinal development is correlated w
hiatus at the base of the Wolfcamp s
and with a profound regional break a
zon in China. It is concluded, therefo
natural lower limit of the Permian
base of the Pseudoschwagerina zon

Thionyl Chlorofluoride

THIONYL fluoride, SOF_2, was obta
Meslans in 1896 by the action of z
certain other metal fluorides on thio
Moissan and Lebeau in 1900 obtaine
chloride by the action of free fluor
trifluoride on thionyl chloride.
thionyl chlorofluoride, $SOClF$, was n
this has been discovered by H. S.
Mericola (*J. Amer. Chem. Soc.*, **62**,
the action of antimony trifluoride on
in presence of antimony pentachlori
It is a liquid, b.p. 12·2°, m.p. –139·
It reacts with very few metals at t
to 150°, but with copper and mercury
occurs at room temperature and w
The products are thionyl fluoride,
and the sulphide and chloride of th
$SOClF$ probably first decomposes into
and it is found that gaseous $SOCl$
decomposition very slowly at room
new determination of the freezing
chloride gave –99·5°.

Surface of Solutions

IN papers by J. W. McBain, W. V
Vinograd and D. A. Wilson (*J. A*
62, 239, 244; 1940) some novel res
the use of the film balance and the
muir trough with ordinary solution
These bear little relation to previ
derived from analogy with insoluble
films on water. The various pheno
pressure and of time frequently pass
maximum in an intermediate range o
Whether a pellicle forms or not dep
centration and the degree of compre
face, and when a pellicle is formed a
compressed, the final pressure is ch
of the substance. The initial pressure
where the final pressure vanishes

apparatus, consisting of a film balance divided into two compartments by a water-tight flexible float, has been used with solutions of hydrocinnamic acid, potassium laurate, sodium butylbenzene sulphonate and lauryl sulphonic acid. The surface tension of hydrocinnamic acid solutions is not fully established until after periods of time enormously greater than those expected from classical diffusion processes. A type of curve with a minimum is established, and in this a trace of solute first lowers the surface tension of the solvent while further small addition raises the surface tension to a low maximum or constant value (lauryl sulphonic acid; sodium butylbenzene sulphonate). With potassium laurate, addition of alkali appears to lower the flat maximum to the value of the minimum.

Nitrogen Tribromide

Nitrogen chloride and iodide have been known for many years, but the bromide has not yet been isolated. Bromine appeared to be as passive towards nitrogen as towards oxygen, oxides of bromine having been discovered only within recent years. The existence of NH_2Br and $NHBr_2$ in solution seems fairly certain, and the azide N_3Br has been prepared, but the compound NBr_3 has not yet been obtained. Recent investigations, however, of the mechanism of the reaction between ammonia and bromine at low temperatures (Schmeisser, *Naturwiss.*, 28, 63; 1940) show the existence of an ammoniate of nitrogen tribromide with the formula $NBr_3.6NH_3$. The compound was obtained when bromine and excess ammonia were mixed at 1–2 mm. pressure, and cooled to $-95°$. It is a dark purplish-red compound, which decomposes violently above $-70°$ into nitrogen, ammonia, and ammonium bromide, according to the equation $NBr_3.6NH_3 = N_2 + 3NH_4Br + 2NH_3$.

An Acoustic Generator

Prof. Hartmann of the Physics Laboratory of the Technical College, Copenhagen, discovered more than twenty years ago that if a small resonance tube is placed with its mouth facing a nozzle from which air at a pressure of a few atmospheres is issuing, at certain distances from the nozzle the resonator becomes the source of a note of high pitch and considerable intensity. With the aid of funds from the Carlsberg, Oersted and Mansted Foundations the mode of action and the best form of the apparatus have since been investigated by Prof. Hartmann and his assistants, and the results are collected in a well-illustrated paper of more than 200 pages by himself, Peter and Elisabeth Mathes and Freimut Lazarus (*Ingeniorvidenskabelige Skrifter* of the Academy of Technical Sciences, No 4; 1939). In general, the jet of air issues from a nozzle of 2–6 mm. diameter, the excess pressure being 1·8–4·8 atmospheres, and the resonator has its diameter and length equal to the diameter of the nozzle. The wave-length of the note emitted varies from 1 to 5 cm., according to the position of the resonator and the air pressure used. The intensity of the sound is measured by the Rayleigh disk, the pressure disk, and three other methods. It is greatest in a direction nearly at right angles to the axis of the apparatus, and the acoustic efficiency is a maximum of about 5·5 per cent when the excess pressure is 1·5 atmospheres.

Sensitometry of Photographic Material used in Astronomy

D. R. Barber, Norman Lockyer Observatory, Sidmouth, has published a paper on this subject (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940) in which he gives a full description of his investigation on the influence of three different developers upon various negative materials, comprising three blue-sensitive, three 'orthochromatic', and three panchromatic emulsions. A variety of diverse characteristics is essential for the ideal developer, from the astrophysical point of view, among which may be noted high contrast, combined with a low value of background (chemical) fog, and freedom from excessive graininess in the case of super-speed materials. In actual practice, however, a compromise is essential, since a pronounced reduction of graininess resulting from the use of ultra-fine emulsions, or specially compounded developers, will be obtained only at the expense of a lowered effective threshold response. Each plate was calibrated by the tube sensitometer (*Bull. Norman Lockyer Observ.*, 1, 14; 1938), and blue light through a Wratten No. 47*a* cemented filter, having a transmission band from 3750 A. to 5200 A., was used in the calibration, as the effective response of a photographic material is known to depend on the quality of the radiation incident upon it. A number of diagrams shows the change in the effective response of the emulsion at different densities, and this is expressed as a magnitude gain or loss, referred to standard development. The main conclusion reached is that the standard metol-hydroquinone developer, even when used with a wide variety of sensitive materials, always produces results most suitable for use in astronomical photography.

Alpha Photometric Observations of the Solar Spectrum

David S. Evans has published a paper criticizing some of Unsöld's views, in particular that which suggests that the Balmer series of the solar spectrum is formed effectively by pure absorption (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940). Evans undertook a programme of observations of the centre-to-limb variations in the contour of $H\alpha$ and carried out the work with the Oxford solar telescope. The spectroscope used was of the Littrow form with two 60° prisms and one 30°. Its aperture ratio was the same as the telescope, its dispersion being 2·06 A. at $H\alpha$ and 1·47 A. per mm. at the sodium D lines. At the suggestion of Prof. H. H. Plaskett, the D lines of sodium in absorption were used for the determination of the instrumental pattern of the spectroscope and of the amount of scattered light; a preliminary account of the method appeared in the *Observatory* (62, 231; 1939). A new method of drawing characteristic curves was used, and if this introduced errors into the results, these would have revealed themselves as a correlation between determined residual intensity and plate opacity. No such correlation, however, was found for plates ranging in opacity from 0·40 to 0·97. A comparison is made with the results obtained by other workers, Minnaert, Thackeray, Royds and Narayan. The low value of the equivalent width found by the last two workers is suspected to be due to their lack of precautions to guard against scattered light. On approaching the limb, it has been found that the residual intensity increases at each wave-length. There is some support for the view that uncompensated cycles are not of importance in the formation of $H\alpha$.

THE EGG AS FOOD

ONE of the most difficult of the tasks which has always confronted the scientific worker possessed of a proper appreciation of his responsibilities to society has been the choice of a way of making his results known so that they will do most good. Material of an abstruse or technical nature is fitly presented to a learned society. Such a society, however, only comprises producers of knowledge. It is much more difficult to pass on knowledge to the consumers: those who make use of it. Nutrition is a branch of science which applies so directly to the population at large that any attempt to shorten the distance between the scientific investigator and the dining-table is to be viewed with especial interest.

The Nutrition Panel of the Society of Chemical Industry, the membership of which is made up of workers in all branches of science ranging from the academic Scylla of biological oxidations and reductions to the practical Charybdis of canning, has conceived itself to be peculiarly well fitted for the task of disseminating the knowledge of nutrition. A series of meetings has been planned at each of which a single food will be discussed. These meetings are not addressed to a purely scientific audience, neither are they intended to be 'popular'. Rather are they for all those whose business it is to take an intelligent interest in nutrition.

The first meeting of the series was held on April 24 and was concerned with the egg as food. Besides the members of the Society of Chemical Industry itself, representatives of educational, agricultural, and medical associations were invited, as well as members of the great women's associations interested in general welfare.

Dr. Joseph Needham, of the Biochemical Laboratory, University of Cambridge, who spoke on "The Biological Nature of the Egg", pointed out how complex is the structure of the eggs of birds and other vertebrates. In fact the embryo, which is eventually to develop into the new animal, only occupies a very small space within the whole egg. The remainder serves, in one way or another, to keep the organism alive until it is hatched. It is interesting to note that this is not the case among lower animals. The young octopus in its egg is not supplied by its mother with enough copper with which to make its blood pigment, but must obtain more for itself from the surrounding sea. Newts and frogs in their eggs also depend on the environment for water. Birds' eggs, however, represent a type of perfectly 'closed-box' structure which requires many ingenious devices in order to survive. One of these, by which the bird saves itself from being poisoned by its own by-products, is the fact that the developing embryo does not excrete nitrogen as ammonia or urea but in the form of uric acid, which is more easily deposited as crystals.

Dr. Ethel M. Cruickshank, of the Department of Agriculture, University of Cambridge, who spoke on the "Chemical Composition of the Egg", pointed out that the hen can be regarded as a physiological machine for turning raw materials into human foodstuffs. The amount of such human food that the hen can produce in a day depends on a number of factors, but to a large extent it is true to say that the bigger the hen the larger the egg. The number of eggs a hen lays in a year is a different matter; an interesting point is the fact that high production has little or no detrimental effect on the quality of the eggs. In considering the composition of the egg one must divide it into three parts. The shell is principally made up of calcium carbonate, although small amounts of magnesium, phosphorus and organic matter are present. The 'white' is composed of at least four different proteins and can be divided into layers of thick and thin white. The proportion of thick to thin white influences the culinary value of the egg. Together, the proteins in the white contain all the essential amino acids for 'first-class' protein. Egg white contains minerals and also supplies valuable amounts of vitamin B_2. The yolk contains two proteins which are also found to be of 'first-class' quality. Besides protein the yolk contains 30–32 per cent fat. Numerous minerals are present, including relatively large amounts of easily assimilable iron. Vitamins A, D, B_1 and riboflavin are also present. The anti-rachitic vitamin D is of great significance in the diet. Dr. Cruickshank also discussed the factors in the diet of the hen which might give the yolk an unpleasant taste or a strange colour. Although the amount of fat, and hence the total food value of the egg, can only be influenced to a slight extent by the diet of the hen, the nature and flavour of the egg can be very strikingly altered by feeding mashes containing, for example, hemp seed or linseed oil. As to vitamins, it is essential that they should be abundantly present in the diet of the hen in order that her eggs may be of high nutritive value: and it is well known that a thin shell is obtained by feeding a hen a diet poor in calcium. However, the calcium contents of the yolk and the white are not affected. The amount of iodine in eggs is affected by the amount in the hens' food, although iron and copper appear to be independent of the amount present in the diet.

Dr. S. K. Kon, of the National Institute for Research in Dairying, Reading, spoke on the nutritive importance of eggs in the diet. He stressed that eggs share with milk the ability to cover nutritive requirements during the period of rapid development. The shortage of vitamin D and iron in milk is admirably supplemented by eggs; the deficiency of eggs in calcium is made good by their association with milk. The vitamins, minerals and 'first-class' protein in eggs make them one of the protective foods. In particular, eggs supplement very well the proteins present in cereals. Dr. Kon showed in detail how eggs contribute to the various factors of a good diet.

Dr. R. B. Haines, of the Low Temperature Research Station, Cambridge, spoke on the preservation of eggs. He pointed out that hens' eggs are in a state of rapid change. The aim of storage is to retard or stop this change and prevent the attack of outside agencies such as micro-organisms. Although storage only affects the nutritive value of eggs to a very minor degree, any loss of palatability and cooking quality is a clear indication that certain slight chemical changes have taken place. Dr. Haines mentioned three methods for the large-scale storage of eggs—cold storage, storage with the partial addition of carbon dioxide, and full gas storage. For other purposes, drying or freezing can be used. Problems connected with the storage of eggs lead to the consideration of questions of production and handling. For example, 'thick white' is apparently due to the individual hen. Again, spoilage of eggs by the invasion of bacteria is influenced by the structure of the egg-shell, which may vary greatly in successive eggs from the same hen or by the 'washing' treatment which the eggs receive. Among many other topics upon which Dr. Haines touched were 'swollen' and 'flabby' yolks due to loss of moisture, 'watery whites', 'sunken' and 'sided' yolks due to chemical changes and eggs with 'whiskers' due to the growth of fungus on the shell.

Miss Mary Andross, of the West of Scotland College of Domestic Science, Glasgow, gave the final paper on the subject of "The Cooking of Eggs". Research in domestic science concerns itself with the effects such factors as temperature, time, rate of cooking, acidity, or the addition of salts may have on the nutritive properties of eggs which are boiled, poached, fried, scrambled or made into omelets, custards, mayonnaise, meringues, angel cakes, or sponge cakes. Another important factor which is the subject of scientific investigation is the effect of the age of the egg in relation to its cooking qualities. Miss Andross presented the results of a large amount of her own original work on these points. She also discussed the waste of food value which may take place in different methods of cooking. In making a scrambled egg, for example, 13·5 per cent of the original food value is left behind in the various bowls and dishes used in cooking it. Miss Andross concluded by discussing the effects which different treatments may have on the digestibility of the food.

In the course of a general discussion a number of further points were considered. These included the 'too fresh' egg; the problem of sensitivity to egg white; coagulation of egg proteins during cooking; reconstitution of dried eggs; and many others.

If the following meetings of the series on other foods are as complete as the first, the collected papers will form a text-book of unrivalled excellence. It would only then remain to see whether the farmers, administrators, cooks and diners of England are availing themselves of the information thus collected to determine whether the plans of the Nutrition Panel have succeeded.

FUNDAMENTALS OF CLASSICAL ELECTRIC AND MAGNETIC THEORY

By Dr. G. Burniston Brown
University College, London

Ever since the Committee of the International Electrical Congress in 1932 was forced to resort to a majority vote in order to decide upon the introduction of the Oersted, the general uneasiness of physicists with regard to the difference between induction and force has been augmented rather than allayed; and all the more so when the secretary of the committee, Prof. Henri Abraham, maintained that there were at least six definitions of the permeability (μ), and that it is not possible either to show that they are the same or different[1].

A meeting of the Physical Society on May 3 was devoted to this problem and to a discussion of the presentation of the classical theory of electricity and magnetism in general. The discussion was opened by the present writer, who claimed to show that the first three definitions of μ, which are fundamental to electromagnetic theory, are equivalent. Abraham's last three definitions are concerned with magneto-optics and are not of the same importance.

In order to demonstrate this equivalence the author made use of a point of view which is gaining ground among writers on the philosophy of science, namely, that the ultimate meaning of any concept to which numbers are attached involves the consideration of an act of measurement either in an actual experiment or in a "theoretical-experiment". This may be looked upon as a special form of the general thesis put forward by Ogden and Richards in their book "The Meaning of Meaning"[2], that all meaning involves what they termed a "sign-situation". In the special form given above, it is the basis of Sir Arthur Eddington's philosophy of science, and he has called a sign-situation a "gesticulation"[3].

If this principle is applied to the concepts of "force on a pole" and "force on a current element", it can be shown that the former requires a rod-shaped cavity and the latter a disk-shaped cavity for the act of measurement, and thus the cavities of the classical treatment of Maxwell and Kelvin arise naturally instead of arbitrarily. Application of the same method to the theoretical-experiment in which the principle of the conservation of energy is used to show that the induced electromotive force is equal to the rate of change of magnetic flux, shows clearly that it is the rate of change of the normal induction which is involved and not the force. This is not often shown clearly in the text-books.

Use can be made of Poisson's fictitious-layer theory to find the force in the cavities. Poisson's treatment rests solely on the inverse square law, and the assumption that the field of a polarized substance can be treated as consisting of the fields of a large number of doublets. If we take the number of doublets per cubic centimetre to be n and their polarizability α, then we readily find the relation with K, the dielectric constant, to be

$$K = 1 + 4\pi n\alpha.$$

This formula is derived directly from classical macroscopic theory and has the great advantage that it is independent of theories of molecular structure. It assumes that the polarization is proportional to the internal field but is independent of whether the polarization is due to separation of charges or rotation of doublets already present. It seems that Mossotti took the polarization to be proportional to the external field, and this causes his formula to differ from that given above. The formula of Clausius, since made great use of by Lorentz and Debye, would, however, seem to involve an unjustifiable mixture of macroscopic and microscopic considerations. One way of putting it briefly is this: a piece of dielectric is placed in the field of a condenser and Poisson's fictitious-layers of charge are placed on its boundary; then a spherical portion (which is also large compared with molecular structure) is removed, but in this case Poisson's surface charge is omitted and it is considered from a purely microscopic point of view. The result is that there is difference between the formula of Clausius and that of Mossotti. This has been overcome by adopting the former, using a hyphen, and calling it the Clausius-Mossotti formula!

Another application of the epistemological principle already mentioned, namely, that a physical concept receives its precise meaning in an experiment or theoretical-experiment, is of great use in clearing the obscurity that surrounds the theory of dimensions. The dielectric constant K and the permeability μ do not, in some mystical way, tell us anything about the 'nature' of electricity and magnetism, or the difference between them. K and μ are symbols and mean just as much as their definition implies and nothing more. K is defined as the ratio of numbers obtained by the same conventional set of operations performed first on the material in question, and secondly on free space. It is easy to show that μ is exactly analogous to K. Consequently, both K and μ are dimensionless. In the determination of the ratio of the electrostatic to the electromagnetic system, it is usually forgotten that the conventional set of operations is different: in the case of the capacity of a condenser, for example, only a scale is required on the E.S. system, whereas on the E.M. system a clock is required in addition. The symbols representing the operation (the dimensions L and T) do not therefore cancel and the ratio is c^2 cm.^{2}/sec.^{2}. In the expression for the velocity of electromagnetic waves, $\frac{c}{\sqrt{K\mu}}$, it is c which has dimensions.

In the discussion which followed, there seemed to be general agreement that the formulæ of Mossotti and Clausius are not free from errors in their derivation. Strong resistance was, however, shown to the attempt to deprive K and μ of their dimensions, and declarations of faith that B and H were 'really' different were made, including that of a former member of the International Committee. Other difficulties, such as that of providing a satisfactory proof of the expression for the energy involved in a hysteresis-cycle, were also discussed.

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[1] Abraham, H., "A propos des unités magnétiques", *Bull. Nat. Research Council*, 93 (Washington, 1933).

[2] "International Library of Psychology, Philosophy and Scientific Method." Kegan Paul (1923).

[3] *Proc. Roy. Soc.*, A, 174 (1940).

GEOLOGY IN GREAT BRITAIN

Reports for 1936 and 1937

PART I of the "Summary of Progress of the Geological Survey of Great Britain" for 1936[1] contains an appreciation of the work of the late Dr. Bernard Smith, who had held the office of director for less than a year at the time of his death in 1936. Pending the appointment of a new director, Dr. W. E. P. McClintock served as acting director and was in general charge of the Survey and Museum until the new director, Dr. E. B. Bailey, took up duty. The report gives the usual particulars of the routine work carried out during the year under review. Forty maps and ten memoirs were issued, some of which have already been reviewed (see NATURE, 141, 696; 1938).

Part II[2] contains a series of papers on subjects of special interest. The stratigraphy of the Upper Coal Measures of South Lancashire is described by R. C. B. Jones and compared with that of North Staffordshire and North Wales. W. B. Wright contributed an account of the Anthrocomyas of the Lancashire Coal Measures in a paper which claims to be the first serious attempt to show that the detailed Lancashire system of sub-zones has a stratigraphical significance elsewhere, notably in Scotland, where eight of the sub-zones have been detected in their appropriate sequence. C. J. Stubblefield places on record information concerning the availability of specimens of fossils figured in the 1848 memoir on the Malvern Hills and other Palæozoic districts. Borings are described by R. L. Sherlock (through a Keuper succession in Shropshire) and M. Macgregor (through Carboniferous strata in Lanarkshire). An investigation of underground water pressure in the Spilsby Sandstone of Lincolnshire is recorded by H. H. Swinnerton. Structural features in the metamorphic rocks of parts of Shetland, notably the striations known as 'lineation', are described by T. Robertson. Improvements in the Lawrence Smith method of alkali determination are suggested by C. O. Harvey.

In the "Summary of Progress" for 1937[3] (no longer called Part I), the new director gives an interesting history of the changes in scope which the "Summary of Progress" has gradually undergone since its introduction in 1898 (for 1897) by Sir Archibald Geikie. Since 1927 the "Summaries" have been divided into two, or sometimes three, parts, the second and third parts being devoted to contributions on special topics, such as those referred to in the preceding paragraph. It has now been decided to issue papers or monographs of this kind in an independent publication to be called the *Bulletin of the Geological Survey of Great Britain*. The first two *Bulletins* have already appeared and are noticed below. It is also announced that it is intended to issue regional accounts of the ore deposits of particular districts. Devon–Cornwall and the South Pennines were selected for examination during 1938. Twenty-two maps and eight memoirs were published during 1937, and at the close of the year there were forty-four maps and six memoirs in the press. The "Summaries" for 1938 and 1939 are not yet available.

Bulletins

Bulletin 1[4] contains nine papers, of which six are concerned with the Carboniferous System. The discovery of a marine band with goniatites is announced by L. H. Tonks from the Middle Coal Measures of Co. Durham. R. Crookall reviews all the available evidence regarding Kidston's claim that an almost complete change in the recorded plant life of the Carboniferous occurs at a particular level in the Millstone Grit of Britain. The conclusion is reached that only two plants have been satisfactorily proved to trespass from one side to the other of this so-called plant 'break'. An interesting account is given by M. Macgregor of old coal-workings encountered during excavation for hospital foundations at Cowglen, near Glasgow. Much new information is furnished regarding the freshwater mussels of the Coal Measures: in Yorkshire, by W. B. Wright; and in Lancashire, by W. Dewar.

A description of unusual palæontological interest is given by F. W. Anderson of a Lower Carboniferous species of a rare group of echinoderms; although this particular species had not been previously recorded, thirty-three specimens are crowded upon a single small slab collected from the core of a boring in the Scremerston Series in Northumberland. Those interested in the Jurassic will find an important paper by L. F. Spath on the ammonites of the Warboys pit in the Oxford Clay of Huntingdonshire. C. O. Harvey contributes a description of a simple method for determining water in silicate analyses. The history and use of the petrographic term 'plagiophyre' are outlined by A. G. MacGregor, who proposes that in future it should be used only as a group-name. The *Bulletin* is effectively illustrated and has an adequate index.

Bulletin 2[5] maintains the high standard of the first number and contains eight papers on subjects covering a much wider range of interest. A. F. Hallimond and J. T. Whetton demonstrate that a magnetometer survey can be usefully undertaken in search of hæmatite ore-bodies under considerable depths of cover. An account is given of a magnetic survey in South Cumberland and Furness. The difficulties of the method are critically considered. In another paper A. F. Hallimond describes magnetic observations on the Brockhill dolerite dyke of Worcestershire. Certain oil seepages in Lancashire, of which the most important occurs in peat near Formby, have been investigated by F. W. Cope; a biological report is added by Kathleen B. Blackburn. Both authors conclude that the oil is of underground origin and is not a derivative, as formerly supposed, from modern plants in the peat. J. E. Richey and W. Q. Kennedy describe in detail their recent researches on the Morar anticline with its Sub-Moine core and its envelope of Moines. The two series appear to be separated by a great unconformity.

E. B. Bailey reviews the Caledonian structural elements of Skye; he confirms, with some modifications, Clough's reading of a tectonic window near Ord. New reasons are given for regarding the Tarskavaig 'Moines' as Torridonian. Rocks of the Moine Series are also described by T. Robertson, these being in and near the Garry-Ericht water-tunnel of the Grampians. Special attention is given to structural features, including lineation. In south-west Cornwall the Meneage Crush-Zone has long withstood satisfactory stratigraphical analysis. C. J. Stubblefield now records the presence of Lower Devonian strata at two localities and throws considerable doubt on former identifications of alleged Ordovician and Silurian fossils. R. Crookall describes plant remains in a red sandstone regarded as probably of Lower Carboniferous age.

MEMOIRS

The volume on Area I of the "Economic Geology of the Central Coalfield" of Scotland[6] completes a series of nine memoirs on this important region. It describes in detail the mineral resources of the Kilsyth–Kirkintilloch district, an area of 66 square miles mainly in Stirlingshire and Dumbartonshire. Along the north are the steep slopes of the Kilsyth Hills and Campsie Fells. The through valley that has formed a natural line of communication between the Forth and Clyde throughout the centuries stretches across the area. The south-eastern part is undulating drift-covered moorland, relieved by hills and crags where dolerite sills come to the surface. Apart from superficial deposits, which provide good building sand and gravel, and a small inlier of Old Red Sandstone, the rocks described are of Carboniferous age. The Limestone Coal Group, around which centres the chief economic activity of the district, has long yielded coal and ironstone. In recent years anthracite has been successfully exploited. Such products as limestone, building stone, moulding sand and fireclay are provided by other strata, and large quantities of road metal are obtained from the well-known quartz-dolerites of Kilsyth. Special chapters are devoted to the structure of the area and to more systematic descriptions of the various economic products.

The memoir describing the geology of the "Shrewsbury District"[7] deals with some of the most geologically attractive parts of Shropshire, including the Longmynd, Caer Caradoc and the Wrekin, where Pre-Cambrian rocks appear boldly at the surface; and Wenlock Edge, made famous by Murchison in his pioneer work on the Silurian System. The district is remarkable for the great variety of its rocks and fossils and for the immense range of time which they represent. As a result many geologists have here received their first training in field work, and some of them have returned to repay their debt by detailed research. The Survey geologists have done full justice to a classic area of unrivalled interest. Successive chapters deal with the Pre-Cambrian, Cambrian, Ordovician and Silurian rocks; the Carboniferous formations of the Coalbrookdale coalfield and the minor fields near Shrewsbury; the Bunter sandstones and pebble beds; and the superficial deposits, mainly glacial, which lie across the outcrops of all these 'solid' formations. Mineral products and water supply form the subjects of the final chapter. A series of appendixes includes two of special interest: "Fossil and Fossil Locality Lists" and "Age-Determinations by the Helium Method". The latter records the ages of the Clee Hills and Little Wenlock basalts as 240 and 260 million years, respectively, and so confirms the Carboniferous age now assigned to them.

The "Wigan District"[8] is mainly occupied by the productive Coal Measures of the western half of the South Lancashire Coalfield. In the west and south-east these lie below a covering of Triassic sandstones, while to the north-east the Lower Coal Measures and Millstone Grit rise to form a high moorland that merges into the Pennine uplands. Over the lower ground lies a widespread mantle of glacial deposits which in turn are partly hidden in the west by wind-blown sands and peat-mosses. The memoir records important additions to our knowledge of the Coal Measures. Zonal correlation by freshwater faunas has been extended well into the area from the adjoining Manchester sheet. Many new features of tectonic interest have become apparent and are recorded in a valuable chapter on structure and faulting. The Upper Coal Measures are found to be unconformable on the Middle Coal Measures, certain folds in the latter having been formed prior to the deposition of the former. Fossiliferous Permian marls discovered in the south of the area are of economic importance in regard to the exploration of the coalfield concealed beneath them. Special chapters deal with this topic, and with the palæontology of the Coal Measures, the economic products, and the glacial geology.

REPORTS ON MINERAL RESOURCES

The report on gypsum, anhydrite, celestine and strontianite[9] is now in its third edition. Since the second edition appeared in 1917, anhydrite, which was then a waste product, has become a valuable raw material in the manufacture of ammonium sulphate and sulphuric acid. The gypsum industry has greatly expanded as a result of the development of gypsum plasters and cement. Celestine and strontianite are the only sources of strontium compounds. These are used in the beet-sugar industry, as fillers in special paints and gramophone records, and for red flares in pyrotechny. The report gives details of the geology, mode of occurrence and distribution, mining and quarrying, uses and treatment, and reserves and statistics of these four minerals.

The report on the "Granites of Scotland"[10] brings together in compact form accounts of the distribution, mode of occurrence and leading characteristics of the principal Scottish granites, intended primarily for the use of those engaged in the granite industry. The first three chapters deal in succession with the development of the industry, with the mineralogical, chemical and physical properties of granite, and with the distribution and age-relationships of the occurrences. Later chapters provide details of the granites of north-east Scotland, of the Galloway district in the south-west, and of the Western Highlands. These include all the most important centres. Special attention is given to granites at present being wrought, and an account is given of the methods of working in active use. Other occurrences of granite throughout Scotland are also briefly described. A list of the quarries in operation during 1938 is appended.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936". Part I. Pp. viii+90. 1936. 1*s*. 6*d*. net.

[2] "Summary of Progress". Part II. Pp. viii+83+1 plate. 1938. 1*s*. 6*d*. net.

[3] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1937." Pp. viii+109. 1938. 2*s*. net.

[4] *Bulletin of the Geological Survey of Great Britain*, No. 1. Pp. xi+108+7 plates. 1939. 2*s*. 6*d*. net.

[5] *Bulletin*, No. 2. Pp. xi+96+6 plates. 1939. 2*s*. net.

[6] "The Economic Geology of the Central Coalfield: Area I (Kilsyth and Kirkintilloch)." By T. Robertson and D. Haldane. Pp. viii+169+2 plates. 1937. 3*s*. 6*d*. net.

[7] "Shrewsbury District, including the Hanwood Coalfield (One-inch Geological Sheet 152, New Series)." By R. W. Pocock, T. H. Whitehead, C. B. Wedd and T. Robertson, with contributions by D. A. Wray, C. J. Shibblefield, T. C. Cantrill and W. M. Davies. Pp. xxi+297+8 plates. 1938. 5*s*. net.

[8] Wigan District (One-inch Geological Sheet 84, New Series)." By R. C. B. Jones, L. H. Tonks and W. B. Wright. Pp. xvi+244+9 plates. 1938. 5*s*. net.

[9] Special Reports on the Mineral Resources of Great Britain. 3, "Gypsum and Anhydrite", by R. L. Sherlock and B. Smith; and "Celestine and Strontianite", by R. L. Sherlock. Third edition by R. L. Sherlock and S. E. Hollingworth. Pp. x+98. 1938. 2*s*. 6*d*. net.

[10] Special Reports on the Mineral Resources of Great Britain, 32, "The Granites of Scotland", by J. G. C. Anderson, with a contribution by M. Macgregor. Pp. 70+4 plates. 1939. 2*s*. 6*d*. net. London: H.M. Stationery Office.

RADIO FREQUENCY WAVE GUIDES

WITH the continuous extension of radio research to increasingly higher frequencies, it is not surprising to find occasionally that radical changes in technique and equipment occur. Such changes are already envisaged in the practical application of decimetre and centimetre electric waves, that is, the wave-length band from 1 cm. to 100 cm. So long ago as 1897, Lord Rayleigh gave a mathematical analysis of the propagation of electric waves along hollow tubes of either circular or rectangular cross-section, and showed that this type of transmission could take place only when the wave-length was of the same order as, or less than, the cross-sectional dimensions of the tube. Consequently this subject attracted little attention until about 1935, when suitable methods of generating these very high frequencies had been developed. Since this date the matter has been investigated in some detail in the United States, notably in the Bell Telephone Laboratories and the Massachusetts Institute of Technology, and also to a lesser extent in France and Germany.

A good review of the investigations conducted in the past few years was given by Dr. J. E. Houldin in a paper read on February 19 before the London Students' Section of the Institution of Electrical Engineers. It has been shown by analysis and verified experimentally that several types of waves can exist within the tube, but particular attention has been devoted to four of these. As is to be expected, there is a critical free-space wave-length above which no transmission along the tube takes place. Tubes having diameters of the order of 10 cm. appear to be practically convenient for use in the wave-length band 10–30 cm. By filling a copper or bakelite tube with water, the effective wave-length in the tube is reduced, with certain practical advantages for experimental work.

The velocity of propagation and attenuation of the waves depend upon the type of wave used, the wave-length and cross-sectional dimensions of the tube and the nature of the dielectric with which the tube is filled. It has been shown that at wave-lengths of 10 cm. and below, the hollow metal tube has an attenuation per unit length smaller than that of a co-axial cable of zero dielectric loss and the same external diameter. Owing to the omission of the central conductor and its dielectric supports, the hollow metal tube is simpler and cheaper to construct.

If an open-ended metal tube be excited with oscillations of suitable wave-length, the waves travel towards the open end and are radiated into space. Such radiation may be either vertically or horizontally polarized, or a combination of these, depending upon the type of waves set up in the tube. This radiation is transmitted predominantly forward, and by the use of a suitable flared horn on the open end of the tube, a well-defined beam is obtainable.

Experiments with various horns and tubes have shown that the gain of energy transmitted in the desired direction over that given by an omni-directional radiation is comparable with that obtained in the practical use of antenna arrays on the wave-lengths of 10–100 metres used in the beam system of short-wave communication.

R. L. S-R.

SEVENTY YEARS AGO

Nature, vol. 2, May 19, 1870

Scientific Education

The leading article, under this title, discusses the facilities for training in the sciences available in Great Britain, with special reference to the Royal Commission recently appointed to consider Government aid to science. Referring to the Science and Art Department, it has been questioned whether this scheme has fulfilled the purpose for which it was originated. While the advantages of the scheme have been great, in that it is under the direction of men of the highest eminence, it is contended that the scheme operates mainly for the benefit of the technical schools founded by Government, and thereby forces an official plan of education upon the country. "To such we would remark, that the quantity of Science taught is so small, that it is not wise to attempt in any way to reduce that quantity; but it is certainly to be wished that the Commission should carefully inquire whether this method is one calculated to extend a sound Science education over the whole country".

A plea is made for consideration of the claims of such independent institutions as University College, London, King's College, London, and Owens College, Manchester.

Intellect and Size of Brain

According to the *British Medical Journal*, the weight of the late Sir James Simpson's brain, including the cerebellum, was 54 ounces. While, as is well known, the ratio between intellect and size of brain is by no means close, yet there can be no doubt that it is very important. Most of our great men have had large crania. The male brain ranges between 46 and 53 ounces, its average being 49½ (Quain and Sharpy). That of Cuvier is stated to have weighed 64 ounces, and that of the late Dr. Abercrombie 63 ounces, but it is possible that some error may have crept in through the use of weights of different standards. If not, Sir James's brain, whilst much above the average, did not nearly reach those of the celebrated men we have mentioned; but at the same time, the convolutions were remarkably numerous; they were, says a correspondent, "twisting and turning round on each other as if they could not find room within the head. The island of Reil was very wonderful".

An interesting application of photography to legal evidence has just taken place. The Spanish Government having refused to give up the *Tornado*, an English vessel captured some time since, or to give compensation to the owners, our own Government has acquiesced in the decision, a photographic copy of the private instructions given to the captain by the owners having proved conclusively the more than doubtful character of the vessel.

Correspondence on the "Strange Noises heard at Sea off Grey Town" continues. Charles Kingsley relates his own experiences and suggests that Drum fish (Pogomias) are responsible; Staff Capt. F. J. Evans, F.R.S., also quotes his own experiences and suggests "musical fish or shells"; H. P. Mallet suggests the presence of gas-bubbles rising from a mud containing much vegetable matter.

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 20

Royal Geographical Society, at 5 p.m.—Prof. O. T. Jones, F.R.S.: "Oceanic Shelves".

Tuesday, May 21

Chadwick Lecture (at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1), at 2.30 p.m.—Prof. S. P. Bedson, F.R.S.: "Human Virus Infections of Animal Origin, their Mode of Spread and Control".*

Royal Institution, at 5.15 p.m.—Dr. L. H. Lampitt: "The Manufacture, Preservation and Distribution of Food".*

Thursday, May 23

Society of Chemical Industry (Chemical Engineering Group) (at the Waldorf Hotel, Aldwych, W.C.2), at 6.45 p.m.—Twenty-first Annual General Meeting.

Friday, May 24

Royal Astronomical Society, at 4.30 p.m.—Discussion on "River Flow". (Opening paper by Capt. W. N. McClean.)

Association of Special Libraries and Information Bureaux (in the Lecture Hall of the Science Museum, South Kensington, S.W.7), at 5 p.m.—Discussion to be opened by Dr. L. Newcombe on "The Accessibility of Thesis Literature". Discussion by Dr. J. N. Goldsmith on "Errata and Corrigenda".

Royal Institution, at 9 p.m.—Prof. L. C. Martin: "Ultra-Violet and Electron Microscopy".

Saturday, May 25

British Psychological Society (at 55 Russell Square, W.C.1), at 3 p.m.—H. W. Durant: "A Critical Account of Public Opinion Measurement".

At 5.30 p.m.—J. G. W. Davies: "Individual Differences between Psychological Workers".

At 6.15 p.m.—Alec Rodger and Patrick Slater: Report on "Some New Non-verbal Tests".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Lecturer in Mathematics—The Principal, Science Department, Technical College, Kingston-upon-Thames (May 21).

Headmistress of the County School for Girls, Gravesend—Mr. W. A. Clench, Bank Chambers, Windmill Street, Gravesend (May 25).

Lecturer in Plant Pathology and Zoology—The Principal, Horticultural College for Women, Swanley, Kent (May 31).

Assistant Instructress in Domestic Fruit and Vegetable Preservation—The Secretary and Registrar, Department of Agriculture and Horticulture (University of Bristol), Long Ashton (May 31).

Principal of St. Mary's College (for Women) (University of Durham)—The Secretary, Durham Colleges' Office, 38 North Bailey, Durham (May 31).

Administrative Assistant—The Director of Education, Lindsey Education Office, County Offices, Lincoln (June 1).

Headmaster of Wellingborough College—The Clerk to the Governors, 1 High Street, Wellingborough (June 1).

Lecturers (two) in Civil and Mechanical Engineering subjects, and a Lecturer in Electrical Engineering subjects—The Secretary, Northampton Polytechnic, St. John Street, E.C.1 (June 10).

Lecturer in Botany at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 29).

Teacher of Physics at the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Clifton Road, Rugby.

Director of Education—The Town Clerk, Town Hall, Salford 3.

Engineer for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9113).

Charge Engineer for the Electrical Department of the Federated Malay States—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9018).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 11, No. 3, December 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+199–304. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [104

Reports of the Council and Auditors of the Zoological Society of London for the Year 1939. Pp. 48. (London: Zoological Society of London.) [154

Thirty-seventh Annual Report, 1938–1940, of the Imperial Cancer Research Fund. Pp. 43. (London: Imperial Cancer Research Fund.) [154

Lecture on A Century of Chemistry: "From Boyle to Priestley". Compiled by Richard B. Pilcher. Pp. 43. (London: Institute of Chemistry.) [154

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 8, 1939. Pp. iv+248+52 plates. (London: Brompton Hospital.) 5*s*. [154

Empire Cotton Growing Corporation. A Review of the Work of the Experiment Stations, Seasons 1938–39. By W. Nowell; with a Note on the Entomological Work, by Dr. J. W. Munro. Pp. 18. (London: Empire Cotton Growing Corporation.) 1*s*. 6*d*. [184

The Journal of the Institute of Metals. Vol. 65. Edited by S. C. Guillan. Pp. 479+60 plates. (London: Institute of Metals). [224

Annual Reports on the Progress of Chemistry for 1939. Vol. 36. Pp. 458. (London: Chemical Society.) 13*s*. net. [234

The Nematode Parasites of Plants catalogued under their Hosts. By Dr. T. Goodey. Pp. iii+80. (St. Albans: Imperial Bureau of Agricultural Parasitology.) 10*s*. [234

Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 13: Vegetative Propagation of Tropical and Sub-Tropical Plantation Crops. Compiled by G. St. Clair Feilden. Drawings of Propagation Methods and accompanying Descriptions by R. J. Garner. Pp. 99. (East Malling: Imperial Bureau of Horticulture and Plantation Crops.) 3*s*. 6*d*. [234

Proceedings of the Physical Society. Vol. 52, Part 1, No. 289: Report of a Conference on Internal Strains in Solids, held at the H. H. Wills Physical Laboratory, University of Bristol, July 11th, 12th and 13th, 1939. Pp. viii+178. (London: Physical Society.) 7*s*. net. [244

Hull Bulletins of Marine Ecology. Vol. 1, No. 1: Ecological Investigations with the Continuous Plankton Recorder—Object, Plan and Methods. By Dr. A. [illegible] Hardy. Pp. 58. 5*s*. Vol. 1, No. 2: Ecological Investigations with the Continuous Plankton Recorder—Summary List of Records, 1932–37. Pp. 59–72. 1*s*. Vol. 1, No. 3: Ecological Investigations with the Continuous Plankton Recorder—The Phytoplankton in the Southern North Sea, 1932–37. By C. E. Lucas. Pp. 73–170+64 plates. 12*s*. (Hull: University College.) [15

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 3: Observations on the Œstrous Cycle of the Guinea Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 33–39. 6*d*. Vol. 60, Part 1, No. 4: On the Independence of Linear and Quadratic Forms in Samples of Normally Distributed Variates. By Dr. A. C. Aitken. Pp. 40–46. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [15

Other Countries

Statens Meteorologisk-Hydrografiska Anstalt. Meddelanden, Serien Uppsatser, No. 29: Beräkning av medeltemperaturen vid svenska stationer. Av H. Modén. Pp. 13. 1 kr. Meddelanden, Serien Uppsatser No. 30: Hydrologisk bibliografi, år 1938, Sverige, årgång 5. Pp. 14. 1 kr. Meddelanden, Serien Uppsatser No. 31: Current Meter Discharge Measurements for the Testing of Hydraulic Turbines. By Gustaf Slettenmark. Pp. 9. Årsbok, 19, 1937. iii. Vattenstånden vid Rikets kuster. Pp. 24. 2 kr. Årsbok, 20, 1938. v. Hydrografiska matningar i Sverige. Pp. 12. 3 kr. vi. Aerologiska iakttagelser i Sverige. Pp. 8. 3 kr. (Stockholm: P. A. Norstedt and Söner.) [114

Indian Forest Records (New Series). Utilization, Vol. 1A: The Comparative Strengths of some Important Indian Timbers and their Uses. By V. D. Limaye. Pp. iv+28. (Delhi: Manager of Publications.) 12 annas; 1*s*. [154

U.S. Department of the Interior: Geological Survey. Bulletin 906–C: The Mizpah Coal Field, Custer County, Montana. By Frank S. Parker and David A. Andrews. (Contributions to Economic Geology, 1938–39.) Pp. v+85–134+plates 16–40. 1.50 dollars. Bulletin 906–D: Geology of the Searchlight District, Clark County, Nevada. By Eugene Callaghan. (Contributions to Economic Geology, 1938–39.) Pp. iv+135–188+plates 41–52. 40 cents. Bulletin 910–B: Platinum Deposits of the Goodnews Bay District, Alaska. By J. B. Merthie, Jr. (Mineral Resources of Alaska, 1937.) Pp. iii+115–146+plate 2. 15 cents. Bulletin 916–B: Transit Traverse in Missouri. Part 2: South-Central Missouri, 1908–37. Pp. x+125–296+xi–xiv+1 plate. 25 cents. (Washington, D.C.: Government Printing Office.) [164

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 845: Water Levels and Artesian Pressure in Observation Wells in the United States in 1938. Pp. iv+724. 75 cents. Water-Supply Paper 861: Surface Water Supply of the United States, 1938. Part 11: Pacific Slope Basins in California. Pp. vii+374+1 plate. 40 cents. (Washington, D.C.: Government Printing Office.) [164

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 130: Chemical Investigations on the Fleece of Sheep. By Martin R. Freney. Pp. 52. Bulletin No. 131: Black End and Anthracnose of the Banana, with Special Reference to *Glœosporium musarum* Cke. and Mass. By J. H. Simmonds and R. S. Mitchell. Pp. 63+2 plates. Pamphlet No. 92: The Density of Australian Timbers. 2: Air-dry and Basic Density Data for 172 Timbers. By W. L. Greenhill and H. E. Dadswell. (Division of Forest Products: Technical Paper No. 33.) Pp. 75. Pamphlet No. 94: Some Effects of Alkaline Reagents on Wool. 1: Chemical Studies, with Special Reference to Felting and Shrinkage, by M. R. Freney and M. Lipson; 2: Preliminary Notes on the Physical Properties of Alkali-treated Wools, by E. H. Mercer and M. R. Freney. Pp. 28+11 plates. Pamphlet No. 95: Australian Apples; a Guide to Picking for Export or Local Storage and to the Best Shipping Periods for Export Varieties. Compiled by W. M. Carne. Pp. 55. (Melbourne: Government Printer.) [184

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra. No. 8: Potential Gradient Observations at Mount Stromlo during 1933–1938. By Dr. C. W. Allen. Pp. 34. (Canberra: Government Printer.) [184

India Meteorological Department. Scientific Notes, Vol. 8, No. 85: A Note on Some Measurements of Cloud Heights at Poona, Bombay and Madras. By K. P. Ramakrishnan. Pp. 17–22+3 plates. (Delhi: Manager of Publications.) 8 annas; 9*d*. [184

Twenty-second Annual Report of the National Research Council of Canada, 1938–39. (N.R.C. No. 866.) Pp. 22. (Ottawa: National Research Council of Canada.) [224

Report and Accounts of the National Botanic Gardens of South Africa (and the Karoo Garden, Whitehill) for the Year ending 31st December 1939. Pp. 24. (Kirstenbosch: Botanic Gardens of South Africa.) [224

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 13: Studies in Tropical Fruits, iv. Methods in the Investigation of Respiration with Special Reference to the Banana, vii. Notes on Banana Fruits in relation to Studies in Metabolism. By C. W. Wardlaw, E. R. Leonard and H. R. Barnell. Pp. 27–42+845–860. (Trinidad: Imperial College of Tropical Agriculture.) [224

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 1939. Pp. 350. (Aarau: H. R. Sauerländer et Cie.) [224

University of California Publications in American Archæology and Ethnology. Vol. 38: Cultural and Natural Areas of Native North America. By A. L. Kroeber. Pp. xi+242. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 3 dollars. [224

Revue Internationale des Industries agricoles. No. 1. Pp. 248. (Paris: Commission Internationale des Industries agricoles.) [224

Mazoe Citrus Experimental Station. Report for the Year ending 31st December 1937. (British South Africa Company Publication No. 7.) Pp. xiii+62+4 plates. (Mazoe: Mazoe Citrus Experimental Station.) [224

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1939. (Publication 3586.) Pp. iv+96. (Washington, D.C.: Smithsonian Institution.) [224

Proceedings of the U.S. National Museum. Vol. 88, No. 3083: New Genera and Species of Ichneumon-Flies, with Taxonomic Notes. By R. A. Cushman. Pp. 355–372. (Washington, D.C.: Government Printing Office.) [224

U.S. Department of Agriculture. Technical Bulletin No. 719: Prevention of Damage by the Seed-corn Maggot to Potato Seed Pieces. By W. J. Reid, R. C. Wright and W. M. Peacock. Pp. 38. (Washington, D.C.: Government Printing Office.) 10 cents. [224

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 15: Clinical Organization for Child Guidance within the Schools. By Elise H. Martens. Pp. vi+78. 20 cents. Vocational Division Bulletin No. 202 (Occupational Information and Guidance Series No. 2): Minimum Essentials of the Individual Inventory in Guidance. By Giles M. Ruch and David Segel. Pp. vi+83. 15 cents. (Washington, D.C.: Government Printing Office.) [224

A Living Coelacanthid Fish from South Africa. By J. L. B. Smith. (Reprint from the *Transactions of the Royal Society of South Africa*, Vol. 28, Part 1.) Pp. 106+44 plates. (Cape Town: Royal Society of South Africa.) [244

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THE CONFLICT

> "Arm yourselves, and be ye men of valour, and be in readiness for the conflict, for it is better for us to perish in battle than to look on the outrage of our nation and our altars. As the will of God is in Heaven, even so let Him do."

WITH this quotation from I Maccabees, iii, 58–60, Mr. Winston Churchill closed his first broadcast message since he became Prime Minister. In calm and dignified terms, he outlined the position in the great battle raging across Belgium and into a corner of France. At the time of writing, the battle is continuing, and on it, the first since the War of 1914–18 in which the German armies have met major Allied forces, depends much of the future course of hostilities. But even if this battle goes against us, still the struggle must continue, for, in the Prime Minister's words, it is a "struggle for life and honour and freedom to which we have vowed ourselves".

Now is the moment when the utmost effort must be made. Thanks to the conquest of the air, it is possible for the leaders of the Allied nations to keep in close personal touch, and to devise immediately ways of meeting the German menace from whichever direction it may come; though equally it may be urged that the progress of aviation and radio communication has made possible the onslaught of masses of tanks and other armoured vehicles, and the wholesale bombardment of hundreds of towns in the invaded countries. The answer surely is that force must now be met with force. After years of endeavour, it must be admitted that the principle of settling disputes by negotiation has not been accepted; the world was not ready for it. The task of educating mankind for peaceful progress has received a grievous setback. Nationalism, at first a puny weakling, has grown, passing through the stage of economic sufficiency of the national unit, until now its chief exponent is aiming at domination of Europe and of the world, by utilizing to the full the fruits of scientific and engineering developments.

To meet the menace will require our whole effort. The immediate need is for more tanks, more aeroplanes, more munitions, to replace the ghastly wastage which is going on. Those whose duties are in this field will not fail the cause. But behind these workers must be an army, ever watchful, ever ready, to find ways of defeating new devices of the enemy and also to seek means of increasing the striking power of our Fighting Services. The interests of pure science and the pursuit of knowledge for its own sake must temporarily remain in abeyance. The whole of the intellectual power of Great Britain must be brought to bear on the task of winning the War. Mr. Duff Cooper, the new Minister of Information, broadcasting on May 18, compared Germany with "a mad gambler at roulette, who has gathered all her vast resources and staked them upon red". It is well to bear in mind that Germany has indeed vast resources, in men, in material and in intellect, and her present rulers will exploit them all to the utmost. To meet this appalling menace will test our powers, but not beyond their capabilities.

Great Britain is now represented by a Government including men of most shades of political opinion, and its constitution under Mr. Churchill has been welcomed from all over the British Empire. France also has a Government formed on a wide basis. The two Empires are united in their determination to rid Europe of the tyranny which has come out of Germany. The battle is joined, and the enemy has shown us the importance of speed and efficiency. Yet more speed and efficiency must be our watchwords in the task before us.

INTERNMENT OF ALIEN SCIENTIFIC WORKERS

IN his broadcast address to the nation on May 19, the Prime Minister emphasized that "there will be many men and women in this island who when the ordeal comes on them, as come it will, will feel a comfort, and even a pride, that they are sharing the perils of our lads at the front. . . ." It would be foolish for anyone to ignore the imminence of such peril, and criminal not to anticipate it with the utmost rigour. In the present circumstances, men of science in Great Britain, whether British, naturalized or alien, cannot expect to be shown any form of preferential treatment.

We have made a few random inquiries and find that certain aliens (research workers, academic staff and students) in those universities which are already included in the areas announced for special treatment have been interned. It seems impossible that any man of science, no matter what his political or other views may be, could, in the extremely grave circumstances and in view of the amazing revelations concerning the activities of 'fifth columnists' in other countries, take exception to the internment of alien scientific workers and students. Many have established themselves as first-rate scientists, and a glance through the correspondence columns of NATURE will reveal that they have contributed much to the advancement of science while resident in Great Britain. Yet there can be no reason for assuming that there are no dangerous elements among such men of science, any more than among other types of alien refugees. One communication in reply to our inquiry, however, states: "I feel that there is little case for interning *bona fide* pure research scientists. The numbers of such intellectual workers would surely be too few to affect matters." To this one might fairly ask, what is the minimum number below which such people would prove ineffective, and are we always absolutely certain of an alien's *bona fides*, scientific or otherwise.

On the other hand, another well-known man of science, in response to our inquiry, pointed out that "the problem of lightening the hard lot of the innocent without assisting the fifth column is not a particularly easy one". Still more pointed is the remark from a third reply that: "The attitude of people at this University *who have been interned* is that the measure is obviously good from the country's point of view and they accept the matter philosophically." This contributor continues, "I think NATURE should hesitate before making any kind of *general plea for release of scientific people* who happen to be interned . . . there is always the possibility that some may be more interested than they seem to be in Nazi Germany, and the *first thing at the moment* is the safety of this country from all possible aspects." The contributor first quoted, however, after pointing out that there is little case for interning *bona fide* pure research scientists, continues: "I am sure it would be an excellent thing not only for general human standards, but also for our national war effort's efficiency, if NATURE were to take the whole matter up."

There is no question, in our view, of "general human standards". We know, from inquiries, that those interned are well treated, and some may even be released again soon. We doubt if the internment of these men of science will affect very much our *immediate* "national war effort's efficiency", and we dare to say that any such loss to science is far outweighed by the all-important elimination of risk.

NATURE has striven hard for intellectual freedom in thought, word and action, but now we are seriously up against "evil things". Unity in a common cause must be kept paramount at present. We have attained it, and it is with pride that NATURE directs attention to the brilliant contributions to our war effort that many of our men of science are making in the Fighting Services and research organizations immediately connected with them, to say nothing of the many scientific workers carrying on at the home front. That unity must be preserved until victory is won. No risk is too great in our efforts to preserve it. The activities of the 'fifth column' have revealed to us what subversive potentialities exist in many countries for upsetting whatever unity of purpose has been achieved. Most men of science, therefore, while undoubtedly feeling sympathetic towards our alien scientific guests, must, on the other hand, consider that any form of preferential treatment for scientific workers in this connexion would carry with it a grave element of risk which cannot be justified.

THE PROGRESS OF PHYSICS

Reports on Progress in Physics
Vol. 6. General Editor : J. H. Awbery. Pp. v+434. (London : The Physical Society, 1940.) 22*s.* 6*d.* net.

IT seems curious to contemplate that there are many physicists to-day, well below 'retiring age', who, like myself, began their study of physics under the fond delusion that, sooner or later, they would become masters of their subject. Physics, even then, comprised a considerable body of information, but not more than a student of reasonable ability and not unreasonable diligence might hope to have encompassed by the end of his university career. With Maxwell's electromagnetic theory of light as the keystone uniting the twin pillars of electricity and optics, it was felt that the main outlines of the structure of classical physics were firmly and eternally established. There were, of course, a few details to be filled in, and one or two untidy corners to be cleaned up. In particular, rather curious things happened when an electric discharge was passed through a rarefied gas ; but, after all, why *should* one pass an electric discharge through a rarefied gas, except to amuse the children at the end of a Christmas lecture ? It was confidently expected that, before long, some persevering Teuton would collate the whole subject in one stupendous tome, labelled "Physics", and there the subject would stand, logical, beautiful and complete. Alas ! we were soon to discover that, like Alice in Looking-Glass World, it took all the running that we could do to remain in the same relative position with regard to our knowledge of the subject. We have had to reconcile ourselves to the fact that physics to-day is no longer logical, cannot strictly be described as beautiful ('provocative' would be a more appropriate adjective) and seems unlikely ever to be complete.

Volume 6 of the annual "Reports on Progress in Physics" produced by the Physical Society, which has come to hand, and is the immediate cause of these reflections, contains more than thirteen hundred references to original publications, in spite of the fact that, in accordance with editorial policy, only about one third of the whole subject is covered each year. Imagination reels at the enormous output of new knowledge. The most painful diligence is inadequate to cope with it. All that the most industrious of us can hope to do is to cultivate our own corner of the garden, and trust to these invaluable reports to tell us something of what the other fellow is after.

To the physicist who wishes—as which of us does not ?—to have some appreciation of his subject as a whole, these annual volumes produced by the Physical Society are quite indispensable. Criticism in detail becomes both irrelevant and ungracious unless this indisputable fact is kept steadily in mind. Some "Reports" may be better than others, just as (so my younger friends inform me) "some beers are better than others", and in both cases it is probably largely a matter of taste. In the present volume one is immediately struck by the admirable catholicity displayed by the editor in his choice of subjects for report. Everyone realizes that in certain directions physics is advancing with incredible velocity. Reports on the meson, on induced radioactivity, on stellar evolution, the cyclotron, and liquid helium were almost inevitable. They are all definitely 'news', and could not well have been overlooked ; but it comes as something of a surprise to those of us who used fondly to imagine that it was "all in Rayleigh" to discover how much new work has been going on in sound ; and further, that it is possible to report important advances in such standard subjects as heat, fluid motion, and impedance networks. It is impracticable to enumerate all the separate reports (twenty-seven in number) contained in the present volume, but enough has been said to indicate the wideness of the front on which physics is advancing.

Glancing down the list of authors, one gains the impression that this year the Society has been fielding a rather younger team than usual. There are a few names of international repute, but for the most part the editor has relied on what (if the authors concerned will forgive the phrase) might be called "the rising generation". His team has certainly not let him down, but one has the feeling that some of them might perhaps have let *us* down a little more lightly. It is flattering when an expert says, "I shall assume that you know all about my subject up to, say, three years ago", and one is loath to shatter the illusion of omniscience which one has spent a lifetime in fostering. Nevertheless, one would (with M. Jourdain) be greatly relieved if the expert would "kindly proceed on the assumption that one did not know". The difficulty of striking a happy mean between the 'too elementary' and the 'too advanced' can readily be appreciated. It would, however, be a real tragedy should these excellent volumes of reports become too specialized to meet the needs of the average physicist. The specialist can be left to fend for himself.

An unusual postscript to the volume is provided by Dr. D. Owen (whose impending retirement will, we trust, set him free for still wider activities) in the form of an objective account of the teaching of physics in technical institutions. The whole subject of the training of physicists, and the proper relationship of the universities, the technical institutions and industry is one which demands urgent attention as soon as the times permit. The progress of physics and of industry in Great Britain depends largely on the wisdom which can be brought to its solution. At the moment, we can but file Dr. Owen's report for future reference.

In a world up-side down, it is perhaps not surprising that a little of the type in this volume should be found to be suffering from the same complaint. A few of the diagrams might, with advantage, have been re-drawn. It is, however, such an achievement to have produced the volume at all under war conditions that one must not be critical. Let us hope that nothing will occur to prevent the appearance in due course of its successor. All physicists will await it with eager anticipation.

J. A. CROWTHER.

HOW WE THINK AND WHY

The Nature of Thought

By Prof. Brand Blanshard. (Library of Philosophy). Vol. 1. Pp. 654. Vol. 2. Pp. 532. (London : George Allen and Unwin, Ltd., 1939). 32*s*. net.

PROF. BLANSHARD is here exploring the debatable and largely unoccupied territory which lies on the borders of psychology, logic and metaphysics. His book might almost be described as a dissertation on the meaning of the prepositions 'of' and 'about' as they are used when we say we are aware of something or think about something. The author is a follower of Bradley and Bosanquet. As their point of view is not very popular at present, it is useful to listen to one who is a persuasive advocate of it and an acute critic of other views put forward recently by British and American philosophers and psychologists. He is clear and forcible in expression, as was Bradley, but more temperate. He is thorough in his treatment, as was Bosanquet, but not so difficult.

The first volume is concerned with perception, as the lowest stage of thought, and with ideas, thought freed from its primitive dependence on perception. The author reviews and criticizes the old image theory of ideas, the Behaviourist theory, those of the Pragmatists and various kinds of Realist, and then gives Bradley's view and his own very similar one. "Looked at from without," he says (p. 563), "the idea is seen to be approximating to its object ; looked at from within, it is seen to be evolving toward definition and concreteness. And the two ends lie in line. To become more concretely defined is to approximate to the object, here and everywhere. The aim of thought is to fulfil itself in the reality." He then develops the intriguing but difficult doctrine of his school that aims at obliterating the distinction between particulars and universals, and replacing the notion of the abstract universal by that of the concrete universal.

In the second volume there is first a very interesting discussion of the mental processes of reflection, observation and invention or creative thinking. Then follows one on the nature and tests of truth. The author maintains that coherence is the unique test of truth and is also descriptive of its character. Like other advocates of the coherence theory, he does not seem to meet quite fairly the objection that there might be many systems of truths, each internally coherent and yet incompatible with each other, like the non-Euclidean geometries. This leads him to undervalue what can be said in favour of self-evidence as the test of truth, in favour of the correspondence theory and even of the despised theory that truth depends on authority. That is to say, if thought is not simply to be chasing its own tail, there must be a starting-point in something immediately intuited. Again, thought appears to be of something which is not itself thought but rather an object for thought. The authority theory emphasizes, however mistakenly, the important point that truth is arrived at by a social process and that there exist experts who are less likely to be wrong than those who are inexpert.

The concluding discussion raises two most awkward problems; the problem of external and internal relations and the question whether the notion of cause implies that of logical necessity. The author argues that ultimately there are only internal relations, which implies, of course, that strictly speaking space and time are illusory. He makes, incidentally, some good criticisms of Logical Positivism.

A. D. RITCHIE.

THE OLDEST KNOWN FOSSIL INSECT

By D. J. Scourfield, I.S.O.

On January 18, I gave a detailed account, before the Linnean Society of London, of further specimens of the oldest known fossil insect.

It is still a quite commonly accepted belief that there is no authentic record of fossil insects from rocks earlier than those of the Carboniferous period. Since 1926, however, there has been good reason to believe that insects had at last been found in Devonian strata. In that year Hirst and Maulik[1] described and figured four heads of a small arthropod, which they named *Rhyniella præcursor*, and which they considered to belong to the Insecta. (The jaw-like structures also referred to by Hirst and Maulik, and afterwards named *Rhyniognatha hirsti* by Tillyard, although possibly belonging to a larval insect, cannot seriously be regarded as a definite record of a fossil insect.) These heads had been obtained from the Rhynie Chert, a siliceous deposit of Middle Devonian age, well known to palæobotanists for its beautifully preserved plant remains, and so called because of its occurrence at Rhynie, near Huntly, in Aberdeenshire.

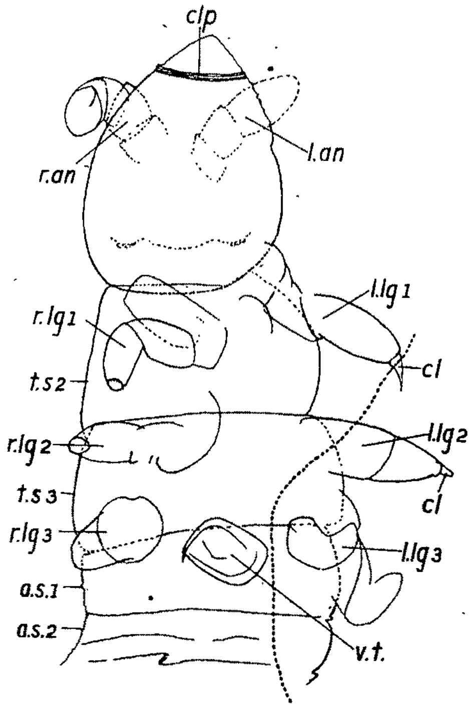

Fig. 1.
HEAD, THORAX AND TWO ABDOMINAL SEGMENTS: WITH ANTENNÆ, PORTIONS OF THREE PAIRS OF LEGS, INDICATION OF VENTRAL TUBE, ETC. DORSI-VENTRAL POSITION. FIGURE VENTRAL. (× 105.)

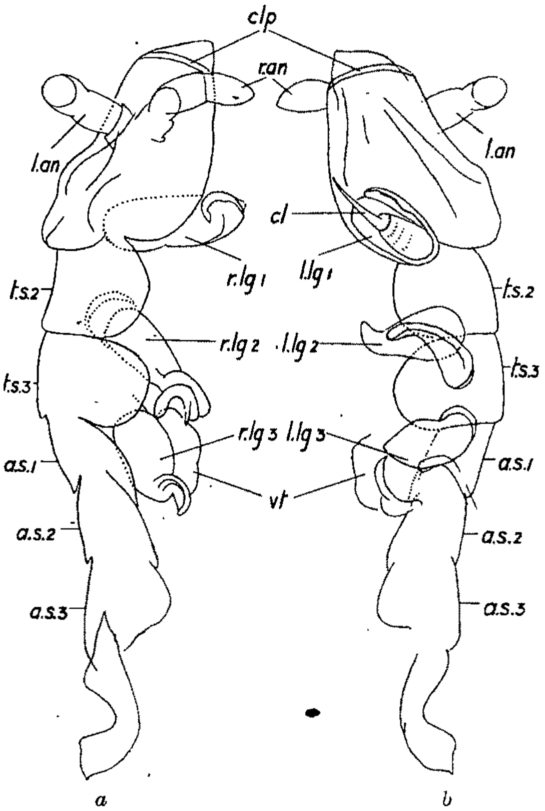

Fig. 2.
HEAD, THORAX AND THREE ABDOMINAL SEGMENTS: WITH ANTENNÆ, THREE PAIRS OF LEGS, ETC. LATERAL POSITION, BUT HEAD NEARLY DORSI-VENTRAL. PROBABLY A CAST SKIN. *a* RIGHT SIDE, *b* LEFT SIDE. (× 105.)

It is true that some doubt has been entertained as to whether these heads were really insectan, but the late Dr. R. J. Tillyard[2], after careful examination of the specimens, was convinced that they belonged to an insect of the order Collembola and might even be of a Podurid type. Coming from such an authority on fossil insects, this opinion seemed pretty conclusive. In view, however, of the great geological antiquity of the Rhynie Chert (some three hundred million years is a modern estimate of the age of the Devonian period[3]) there still appeared to be a possibility that such heads might have been attached to bodies differing somewhat from those of any other insects. This, however, has now been shown not to be the case, and it may therefore be confidently said that Rhyniella was a true Collembolan.

Since the publication of Hirst and Maulik's and Tillyard's papers a number of further specimens of Rhyniella have been found in the same material, mostly by the late Rev. Wm. Cran. These are now in the Geological Department of the British Museum (Natural History), and are described in the current number of the *Proceedings of the Linnean Society*[4], from which the accompanying illustrations are reproduced by courtesy of the Council. Three of the new specimens show heads attached to considerable portions of the bodies (Figs. 1 and 2). It will be seen that the body was elongated, with the segments distinct, thus bringing Rhyniella within the sub-order Arthropleona. They also show that the first thoracic segment (pro-thorax) was without a well-developed tergum, that there were three pairs of legs and that a ventral tube was probably present on the first abdominal segment. No specimen has yet been found with the posterior part of the abdomen intact, and it is impossible to say whether a 'spring' was present or not. The total length of the organism was apparently between 1½ and 2 mm.

Three additional detached heads have also been found, two of which are represented in the accompanying Figures 3 and 4. These heads, while fully confirming the collembolan nature of the mandibles, the conclusion drawn by Tillyard from his examination of the original specimens, also indicate that some at least of the other structures to be found within the head of a recent Collembolan (maxillæ, lingua, etc.) were present in Rhyniella, and further that the animal was provided with ocelli comparable with those of many recent forms.

As was pointed out by Tillyard, the antennae of Rhyniella were typically Podurid, but the absence of a tergum on the pro-thorax indicates affinity with the Entomobryidæ, so that the position of the animal would appear to be intermediate between the two families into which the arthropleonid Collembola are usually divided. This, however, is not a point of very much importance. The remarkable fact is that in all essentials Rhyniella was so similar to modern Collembola that, so far as can be seen, it throws no light even upon the affinities of that group to the other orders of Apterygotan insects, let alone upon the origin of insects generally. What it does certainly show is that the origin of the Collembola, and presumably of Apterygotan insects generally, must have been very much earlier than Middle Devonian.

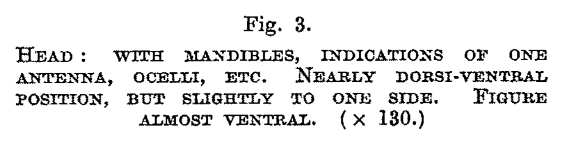

Fig. 3.

HEAD: WITH MANDIBLES, INDICATIONS OF ONE ANTENNA, OCELLI, ETC. NEARLY DORSI-VENTRAL POSITION, BUT SLIGHTLY TO ONE SIDE. FIGURE ALMOST VENTRAL. (× 130.)

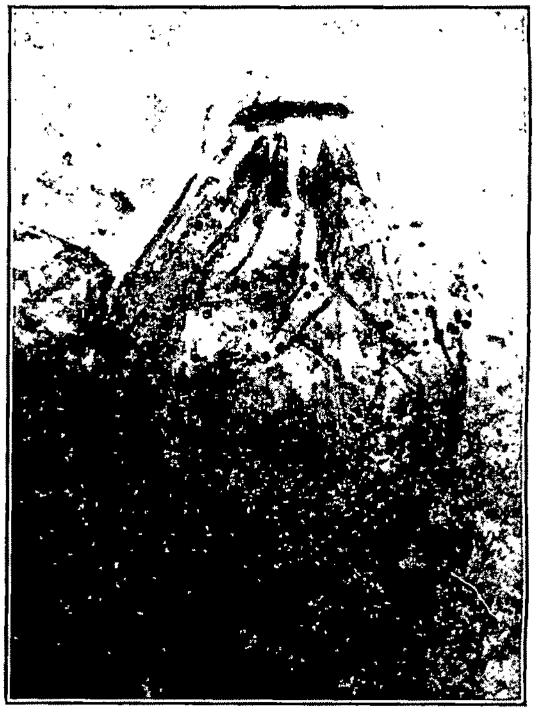

Fig. 4.

HEAD: WITH MANDIBLES, ANTENNÆ, PARTS OF FIRST PAIR OF LEGS, AND MUCH INTERNAL STRUCTURE OF UNDETERMINED NATURE (? MAXILLÆ, ? LINGUA, ETC.). DORSI-VENTRAL POSITION. (× 200.)

Fossil Collembola have so far only been found in three very widely separated geological periods. Before the discovery of the Devonian Rhyniella, the only records were from the Baltic amber of Oligocene age, all belonging to existing genera. Quite recently, however, another form has been found in Canadian amber of Cretaceous age. It has been named by Folsom[5] *Protentomobrya walkeri* and placed in a new family, Protentomobryidæ, intermediate between the Poduridæ and Entomobryidæ, because of the structure of the antennæ on one hand and the absence of a pro-thoracic tergum on the other, as in Rhyniella. It is possible, therefore, that the latter should be included in this new family.

In the discussion following the reading of the paper at the Linnean Society various points of general interest were brought out. Dr. K. Jordan said that entomologists had been convinced, by the study of the morphology of recent Aptera, that these were primitive and not, like lice and fleas, late derivations from winged forms, and now palæontology has confirmed the conviction and turned an opinion into a fact. Dr. F. E. Zeuner thought that the proved occurrence of a specialized group of Apterygotan insects in Middle Devonian material showed that wingless insects were present before winged insects, and that the appearance of the latter coincided with the first forest vegetation on the earth. The earliest tree-like plants were Middle Devonian and it was conceivable that certain Apterygotan insects, which, however, must have been related to the Thysanura rather than the Collembola, took possession of this new kind of habitat and developed wings from lateral pleuræ of the thorax acting as parachutes. Dr. W. T. Calman pointed out the great interest of the glimpse into past conditions afforded by the fortunate discovery of the Rhynie Chert. Prof. F. E. Weiss directed attention to the fact that whereas the plant remains in the Rhynie Chert are of very primitive land plants not directly comparable to any existing groups, Rhyniella can be related to existing Insecta. Similarly in the Carboniferous period, well-developed insects occur comparable to some existing groups whereas the plants are essentially different from recent plants. There seems, therefore, to be a certain lag in the development of modern forms of plants as compared with insects.

[1] Hirst, S., and Maulik, S., *Geol. Mag.*, **63**, 69 (1926).

[2] Tillyard, R. J., *Trans. Entomol. Soc.*, 65 (1928).

[3] NATURE, **139**, 334 (1937).

[4] Scourfield, D. J., *Proc. Linn. Soc. Lond.*, April 25, 1940, p. 113.

[5] Folsom, J. W., *Univ. Toronto Studies*, *Geol. Series*, **40** (1937).

EXPLANATION OF LETTERING OF FIGURES.

an.	Antenna.	*lg.*	Leg.
a.s.	Abdominal segment.	*md.*	Mandible.
cav.	Opening to mandible cavity.	*mo.*	Mouth.
cl.	Claw.	*oc.*	Ocelli.
clp.	Clypeus.	*r.*	Right.
c.s.	Cut by section.	*r.p.*	Rounded projection at base of labrum.
i.a.	Incisor area of mandible.	*t.s.*	Thoracic segment.
l.	Left.	*v.t.*	Ventral tube.
la.	Labrum.		

THEORIES OF THE LIQUID STATE

By Prof. N. F. Mott, F.R.S.,

University of Bristol

A JOINT meeting of the Physical Society and of the Cambridge Philosophical Society was held at Cambridge on April 29 to discuss the properties of liquids. Among other subjects considered were the problem of melting and also the question of how one ought to calculate the viscosity of a simple liquid. It is extraordinary how difficult these problems are and how little progress has been made with them, especially since, if we exclude the quite exceptional case of liquid helium, it seems very unlikely that quantum mechanics has any bearing on the problems; thus all the physical principles necessary for the investigation may well have been available since the time of Clerk Maxwell. It is not so much the difficulty in picturing what happens when a solid melts, as the difficulty in giving mathematical expression to what happens that holds up progress. In fact, all the attempts at exact mathematical treatment start from models which simplify the phenomenon of melting in such a way that some of the essential features are probably lost.

The problem of viscosity appears in some ways as the most fundamental, because fluidity is, after all, what distinguishes a liquid from a solid, though the distinction is not absolute, since many solids, metals, for example, show creep at high temperatures under small stresses. Andrade[1], in 1934, pointed out that the right order of magnitude for the viscosity could be obtained on the assumption that each successive layer of atoms in the liquid glides over the next, and that each layer transfers all its momentum to the next once in each semi-period of vibration. The vibrational frequencies are taken from the characteristic temperature of the solid, and are assumed to have the same order of magnitude in the liquid. Perhaps the most important advance on this simple theory is that of Eyring[2], who attempts to account for the temperature dependence of the viscosity. Eyring considers that one layer of atoms glides over another only at places where, owing to statistical fluctuations, the density is abnormally low; he expresses this by saying that 'holes' form in the liquid, and estimates from the temperature variation of the viscosity that the size of a hole is about one third of the volume normally occupied by an atom. This point of view makes an interesting contrast possible with the state of affairs in solids; whereas in liquids only a very small departure from the normal structure is necessary for glide to take place, in solids, according to recent theories, a 'dislocation' must be formed, which is a type of discontinuity with considerable energy extending over many atoms. According to Orowan[3], creep is due to the thermally activated motion of such dislocations, and the slow creep rates are due to the large energies of activation involved.

We turn now to the question of melting. One of the oldest theories is that of Lindemann[4], who deduced from the known characteristic frequencies of vibration of the atoms in a number of solids that at the melting points the amplitude of their vibrations was always about one seventh of the interatomic distance. Lindemann suggested that when the thermal vibrations reached this value the solid, so to speak, shook to pieces, and that melting was to be understood in this way. Recently Born[5] has considered the problem from a not dissimilar point of view. Born calculates the elastic constants of a crystal as functions of the temperature, and finds that when a certain temperature T_0 is exceeded, the constant c_{44} becomes negative. The crystal is thus unstable with respect to shear, and, according to Born, must therefore melt at this critical temperature.

While it is certainly true that a crystal for which one of the elastic constants is zero or negative cannot be stable, I do not agree that T_0 represents the melting point; the crystal will melt when the free energy $E - TS$ of the solid phase is just equal to that of the liquid. This will occur when the energy E required to break up the crystal into the disordered state, which is equal to the latent heat, just balances the entropy gained by the same process. At the temperature T_0, since there is no resistance to shear, the former term should vanish and there should be no latent heat[6]. Thus the crystal will actually melt at a temperature below T_0. A similar criticism can be applied to all theories which attempt to derive the melting point from the properties of the solid alone; they give only an upper limit for the melting temperature, and to obtain a complete theory the free energy of the liquid must be calculated as well.

The great difficulty here is that, in spite of many attempts[7,8,9], no satisfactory calculation has been made of the entropy S due to the departure of the liquid from the crystalline state. Eyring[7] has suggested that S should be equal to $k \log(N^N/N!)$, which is equal to Nk, where N is the number of atoms, but his arguments have been criticized from a number of sides[10]. I have made[8] a very tentative estimate of the entropy by regarding a liquid as a polycrystalline solid with very small crystal size and calculating the entropy due to the random orientation of the individual crystals. One trouble here is that we do not know how large to take the individual crystals.

If melting is to be regarded as the break-up of the single crystal into some disordered form, we have also to inquire why this disordering takes place at a definite temperature, and not over a range of temperature. Several workers recently[9,11] have been impressed by the similarity between the phenomenon of melting and the order–disorder transitions in alloys. In transitions of this type, although there is in general a sharp transition temperature and a latent heat, the disordering process always begins below the transition temperature. Lennard-Jones and Devonshire[9] have given a theory of melting in which atoms of the solid are supposed to leave their normal positions as the temperature is raised and to go into interstitial positions; at a critical temperature the distinction between normal and interstitial positions is lost, and the lattice breaks up. In this theory, then, the disordering process does begin below the melting point. The theory is applied quantitatively to the solid rare gases; for other solids, however, it can scarcely provide a correct physical picture of melting; in ionic crystals, for example, the activation energy required to bring an ion into an interstitial position is known from the ionic conductivity[12,13], and in metals it can be estimated from the coefficient of self-diffusion. The activation energies are much too large, and in any event the formation of an appreciable number of interstitial atoms before melting would lead to very large anomalies in the specific heat.

If one considers melting as a break-up into a polycrystalline form, perhaps a more plausible picture can be presented, though it does not seem possible to give it any mathematical justification. To take any little piece of the solid in the interior of a crystal and to turn it round so that it has a random orientation will obviously require a good deal of energy; although in principle such displacements may occur below the melting point in a solid, their number will be very small. When, however, *every* little piece of the crystal has been twisted round in some random way, we can well imagine that the work required for each piece is an order of magnitude smaller, just as it is easier to displace a brick when it is one of a heap piled up at random than when it is built into a wall. But arguments of this kind are perhaps unworthy of an exact science, and the theory of liquids badly needs their replacement by some powerful mathematical methods.

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THE COLOURING OF SIXTEENTH-CENTURY HERBALS

BY DR. AGNES ARBER

IN many copies of sixteenth-century herbals the woodcuts are coloured, but we have little direct information as to when, and under what conditions, the painting was done. For this reason it may be worth while to direct attention to certain points which seem hitherto to have escaped notice in connexion with the colouring of one of the most beautiful of these works—"De historia stirpium" by Leonhart Fuchs, published by Isingrin at Basle in 1542. In the description of maize (Cap. cccxviii) the following words occur: "Haec [pictura] in una vagina quatuor tibi granorum colores monstrat, cum tamen quaevis unius duntaxat coloris grana, nempe aut lutea, aut purpurea, aut rufa, aut subcandida omnia habeat. Quod nos, ne aliquem pictura deciperet, monendum esse duximus." This careful explanation that the grains are indicated in four colours—yellow, purple, reddish, and whitish—in one cob, though these variants would not, in fact, be found together, shows clearly that coloured copies must have formed an integral part of the edition, for Fuchs's words would be meaningless if the whole edition had been issued uncoloured.

In painted copies in the libraries of Winchester Cathedral, and of the Linnean Society*, the four colours which Fuchs mentions in the text are represented in horizontal zones in the one maize cob in which the grains can be seen. In similar coloured copies in the University Library, Cambridge (Sel. 2. 81), and in the Library of Corpus Christi College, Cambridge, there is also an attempt at zoning, though the pigments are less well defined. I find, on comparing the general colouring of the two latter copies, that they show certain other points of agreement. For example, both in "Endivien" (endive) and in "Wegwart" (chicory) several flower-heads are shown in blue, while one is indicated in white. This is consistent with Fuchs's descriptions, in which it is noted that both these species are sometimes white-flowered (Cap. cclxii).

A more remarkable case is that of the woodcut called "Lamium" (Cap. clxxvi). It is a composite figure consisting of three shoots growing from a common base, and according to Fuchs's statement, these shoots are intended to represent the yellow archangel, a purple dead-nettle, and the white dead-nettle. In the two copies under comparison, the flowers are distinguished in hue in accordance with the description, and the intention of Fuchs's tripartite picture is thus fully carried out. Moreover, the arrangement is identical in the two copies, the three shoots having yellow, pinkish-mauve, and white flowers, in the order from left to right. In the picture of "Prunus sativa", again, in both copies the tree is so painted as to have yellow plums to the left, blue in the middle, and pinkish-red to the right. Furthermore, in the picture of "Rosa", in both copies the left hand shoot bears white flowers, while those to the right are red.

These examples of accordance in individual details between the colouring and the text, and between different coloured copies, make it probable that the author to some extent controlled the painting. We know that uncoloured copies were also issued, for many of them have come down to us in the untouched state, and some are said to have been painted afterwards by their owners. It is scarcely likely, however, that an amateur, doing the work for his own pleasure, would have taken the trouble to follow out the peculiarities and idiosyncrasies of the text so accurately as has been done in the examples here cited. In the Cambridge University Library copy it is noticeable that the painting is better in its general scheme than it is in the detail, which has a certain rough, mechanical look, which might result from the colourist having to deal rapidly with a number of copies; this is not the kind of imperfection that one would look for in the work of an owner-artist.

Curiously enough, we happen to know something of a much later occasion on which the woodcuts from "De historia stirpium" were coloured before they were sold. In 1774, more than two hundred years after Fuchs's death, a certain Salomon Schinz, who had somehow obtained the blocks cut for Fuchs's herbal, used them to illustrate a book published at Zurich under the title of "Anleitung zu der Pflanzenkenntniss". He had the woodcuts coloured by the children of an orphanage—an economical method of producing *éditions de luxe*, which was apparently not unusual in the eighteenth century. It is pleasant to find that Schinz gives full credit to the orphans, whom he praises in his preface for the pictures, "Durch Euch, liebe Knaben, in Farben dargestellt".

Turning again to the sixteenth century, we may recall Dr. Sprague's crucial discovery[1] that a study of the painted copy of Otto Brunfels's herbal of 1530—"Herbarum vivæ eicones"—belonging to the Kew Herbarium Library, makes it probable that the original water-colours by Hans Weiditz, who illustrated the herbal, were used as patterns for the colours. This view would imply that the Kew copy was painted before it left the publisher's office.

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* For information on this point I am indebted to the librarians of Winchester Cathedral Library, and of the Linnean Society.

The pieces of evidence so far considered are based on a study of coloured copies of the two primary German herbals of the Renaissance. In addition, we already possess evidence of a more factual kind, derived from the records of a great printing house—that founded by Christophe Plantin of Antwerp, who published the herbals of the 'triumvirate' of Low Country botanists—Dodoens, de l'Écluse, and de l'Obel. M. Bouchery, of the Museum Plantin-Moretus, kindly informed me by letter in 1938 that, in the Plantin Archives, numerous references occur to three women who were employed to colour herbals. These were Lisken Zegers; Myncken, the widow of Hans Liefrinck; and Lyncken, the widow of Abraham Verhoeven. Any student, to whom the original documents at Antwerp are accessible, might be able to unravel the exact part played by these painters in relation to the authors, and to the other artists who were members of Plantin's staff.

To sum up, we may say that the evidence here considered suggests that the colouring of sixteenth-century herbals by individual owners was less frequent than has often been supposed; it can indeed have happened but rarely that an amateur was capable of carrying so onerous a task to completion. There seems more probability in the alternative that the colouring was as a rule done officially before the books were sold. If further study shows this view to be of general application, it means that coloured copies deserve more attention than has hitherto been accorded to them, since they may prove to provide an authoritative commentary on the text, and to emphasize the intentions of the author.

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[1] *Trans. South-East Union Sci. Soc.*, **43**, 36 (1938).

OBITUARIES

Prof. Wilhelm Dörpfeld

We regret to record the death of Prof. Wilhelm Dörpfeld on April 26, at the age of eighty-six. Born and educated at Barmen near Düsseldorf, Wilhelm Dörpfeld studied architecture in Berlin, and in 1877 was called from the Prussian Board of Works to be architectural assistant to Dr. Adler at the excavations of the German Archaeological Institute at Olympia, and in 1878 he became technical director. From Olympia he went to help Schliemann at Hissarlik, and collaborated in his publications "Troy" (1884) and "Tiryns" (1886). In 1883 he had married Adler's daughter, and in 1886 he became architectural adviser to the German School in Athens; and in 1887 its 'first secretary', that is, director. After Schliemann's death in December 1890 he continued his work at Hissarlik, revealing the significance of the 'Sixth City' in his "Troja 1893", and reviewing the whole series of discoveries in "Troja und Ilion" (1902).

Meanwhile at Athens he devoted himself to topographical and architectural problems, propounding some original views about the early water supply, and the ground plan of the Erechtheum and Propylaea. He gave remarkable open-air lectures on the sites, and conducted annually a large party of students through Greece, and later also through the islands and to Crete. In 1896, he published, with the philological aid of Reisch, his revolutionary book "Das Griechische Theater", contending that, in the earlier drama, actors spoke not from a raised stage but on the same level as the chorus. After much controversy, this is now generally accepted, though there may be doubt as to the date when the raised platform came into use and assumed the name of the original back-scene (*skenê*).

On the discoveries of prehistoric civilization in Crete, from 1900 onwards, Dörpfeld supported vigorously, but with insufficient local study, the conjecture of Koehler, his predecessor at Athens, that an Aryan culture could be distinguished from a pre-Aryan in the Ægean.

From 1905, Dörpfeld spent much time in excavation in Leucas, which he claimed as the Homeric Ithaca; but neither his rendering of the topography, nor his theory of a general southward shift of island names, nor his archæological finds, have availed to establish the views embodied in "Alt Ithaka" (1927), nor his defence, in "Homer's Odyssee" (1924), of the notion of Helbig that the 'Mycenaean' civilization was of Phoenician origin, and of Conze that the primitive Hellenes practised 'geometrical' art.

After his retirement from the Institute in 1912, Dörpfeld lived in Germany, and held an honorary chair of archæology at Jena; but he frequently returned to Greece, and even excavated at the reputed 'Pylos' of the "Odyssey", and in the prehistoric subsoil of Olympia. Latterly he spent much time in his beloved Leucas, and here he is buried in a tomb prepared by himself overlooking the sea of Odysseus.

Always robust, Dörpfeld was a distinguished figure at the International Archæological Congress so recently as, August 1939. He will be remembered with affection for his remarkable powers of exposition, his gift of inspiring friendship and enthusiasm for his views, his tenacious defence of ingenious theories; but above all for his simple open nature and his delight in the scenes and studies to which he devoted his life.

JOHN L. MYRES.

Dr. C. Davison

With the passing of Dr. Charles Davison on April 28, at the age of eighty-one, at Cambridge, seismology has lost another link with the great pioneers of modern seismology which include the names of Mallet, Milne, Knott, Oldham, Omori, Imamura, Davison and others.

Born on May 1, 1858, at a time when Milne was about seven years old, Davison was the second son of Fleet Paymaster E. C. Davison, and was educated at Armstrong College, Newcastle-on-Tyne, and at Emmanuel College, Cambridge. He spent much of his life as mathematics master at King Edward's High School, Birmingham, and was the author of "Higher Algebra" and "Subjects for Mathematical Essays".

Davison's writings on earthquakes covered a very wide field, including standard and popular books, numerous technical papers and popular articles. He was the leading authority on British earthquakes, 1,191 of which, ranging over a thousand years, he dealt with in his book "A History of British Earthquakes". He had also described the Hereford earthquake of December 17, 1896, and written "A Study of Recent Earthquakes". In 1921 he completed his "Manual of Seismology" and later wrote books on "Great Earthquakes" and "Studies in the Periodicity of Earthquakes".

Since the time Milne was professor of geology and mining at Tokyo, Davison was continuously interested in Japanese earthquakes and Japanese seismologists, some of whom visited him in England. He was the author of the book on "The Japanese Earthquake of 1923" and has written shorter descriptions of many other Japanese earthquakes. The subjects of Davison's scientific and technical papers printed by the seismological societies of many countries, and contained in many geological, philosophical and other periodicals, covered descriptions of individual earthquakes, the history of seismology, velocities of seismic waves, sea waves arising from earthquakes, earthquake sounds, earthquake-recording instruments, earthquake distribution, deep-focus earthquakes, twin earthquakes, volcanic earthquakes, earthquake intensity scales for drawing isoseismal lines and others, the list being by no means exhaustive. To all these subjects he added something of importance. Should it ever become possible to predict the exact time, place and energy of an earthquake, precautions could be taken in advance and many lives and much property saved. Davison no doubt always had this in mind, since on July 31, 1930, he contributed an article to *The Times* on "Earthquakes and Human Life", and he has frequently since 1891 returned to his task of attempting to find any periodicities there may be in the occurrence of earthquakes. He often had occasion to consider the origin of earthquakes, and in 1887 contributed a paper to the *Philosophical Transactions of the Royal Society of London* on "The Distribution of Strain in the Earth's Crust resulting from Secular Cooling", to which G. H. Darwin added a note. For forty-six years, until shortly before his death, Davison was a frequent contributor to Nature on seismological topics.

Before the days of self-recording seismographs Davison did many experiments with pendulums, and often vividly recalled the times when, between two days work, he frequently sat up all night watching his instruments, occasionally being rewarded by the thrill of seeing them move, due to the action of waves from a distant earthquake. For many years he was secretary of the British Association Earth Tremors (now Seismological) Committee, and on the occasion of the recent visit of the Association to Cambridge in 1938, Dr. F. J. W. Whipple and I visited him at his home. Unfortunately, on account of his age, Davison did not feel equal at the time to attending the meetings. He was passionately fond of music and literature, and had an excellent library of gramophone records of Beethoven's works. On March 19, 1934, *The Times* published an article by him on "Robinson Crusoe's Earthquake".

In 1886, Davison married Margaret Blanche Harris, of Great Chart, Ashford, Kent, and had a son and two daughters. E. Tillotson.

I first met Dr. Davison in 1902, when I joined the staff of King Edward's School, Birmingham. At that time the mathematical teaching of the School was under the guidance of a very distinguished teacher, Mr. Rawdon Levett. In the summer of 1903, Dr. Davison succeeded him as senior mathematics master. He made little or no changes in the organization of the teaching, and during the next twelve years a steady stream of able mathematicians passed from the School to the universities. Among them were the last two Senior Wranglers.

Dr. Davison was a tireless worker with a wonderful mastery of detail. He always made use of odd times. Much of his literary work was done in his class room between morning and afternoon school, when other members of the staff would be chatting in the common room. One at least of his many books was entirely written in this way. The report of an earthquake made him very busy, and one of his last pieces of work before he retired was, I remember, an investigation into the transmission of sounds due to the Silvertown explosion during the War of 1914–18.

When he retired from scholastic work in 1920, Davison had well prepared the ground for further academic distinctions. I, who had the privilege of succeeding him and carrying on the mathematical teaching of the School, am glad to put on record how much I owe to his inspiration and wise counsel during the years I served under him. C. H. Richards.

We regret to announce the following deaths :

Prof. C. L. Boulenger, professor of zoology, Bedford College, University of London, on May 19, aged fifty-four years.

Mr. W. H. Massey, M.V.O., formerly consulting engineer to H.M. the King, on May 13, aged ninety.

Mr. Roger Smith, formerly electrical engineer to the Great Western Railway, president of the Institution of Electrical Engineers in 1919, aged seventy-seven years.

NEWS AND VIEWS

The Linnean Medallist for 1940

SIR ARTHUR SMITH WOODWARD, to whom the Linnean Medal for 1940 of the Linnean Society was presented at the anniversary meeting on May 24, was a student of Prof. Boyd Dawkins in Owens College. He entered the Geological Department of the British Museum in 1882, and spent more than forty years in that institution, retiring as keeper of the Department. Between 1889 and 1901 he published four volumes of a "Catalogue of Fossil Fishes", based on a personal knowledge not only of the splendid collection in the Museum, but also of all other important series preserved in all parts of the world. It is a unique publication, a survey by one man of the whole material of a group which has provided that solid basis on which all our recent advances of knowledge of this subject have been built.

But Sir Arthur's interests spread beyond fossil fish to fossil vertebrates in general, and he is very widely known for his collaboration with the late Mr. Charles Dawson in the discovery and interpretation of the Piltdown skull. It is generally recognized that his original interpretation of the many difficult problems, of the reconstruction of this skull from its fragments, and of its significance in the understanding of human origin, was nearer the truth than any other of the many put forward all over the world shortly after the discovery. Sir Arthur has added to the vast mass of detailed accurate information about the anatomy of fossil vertebrates which necessarily forms the body of his work, a series of most illuminating discussions of the broader aspects of palæontology in their bearing on the mechanism of evolution, which have commonly taken the form of presidential addresses to scientific societies.

Linnean Society: Crisp Medallist

THE Crisp Award and Medal for 1940 of the Linnean Society was presented to Mr. D. J. Scourfield, in recognition of the importance of his paper on "The Oldest Known Fossil Insect", recently read before the Society and summarized on p. 799 of this issue of NATURE. The Award, which was established in 1912 by a donation from the late Sir Frank Crisp, formerly treasurer of the Society, is given "as a reward for the best paper, dealing with microscopical research by a Fellow, published by the Society since the previous award". By the terms of the donation it is given "at intervals of not less than five years" but, actually, the period has generally been much longer. No doubt it has been found difficult to define the type of research that could strictly be termed "microscopical", since there are few branches of biological work which do not require at least the occasional use of the microscope. In the case of Mr. Scourfield's paper, however, no doubt could arise, since it was only his unusual skill and long experience in microscopical manipulation that enabled him to elucidate so convincingly the structure of these minute and obscure fossils from the Rhynie Chert. He had already done the same for another arthropod from the same deposit, the remarkable crustacean Lepidocaris, described in his well-known memoir published by the Royal Society in 1926. The debt that British biology owes to the work of amateur microscopists has often been pointed out. Mr. Scourfield worthily sustains the tradition of a long line of distinguished predecessors.

Linen Industry Research Association: New Director

DR. A. J. TURNER has been appointed director of research of the Linen Industry Research Association in succession to Dr. W. H. Gibson. Since 1931 Dr. Turner has been head of the Spinning Department of the British Cotton Industry Research Association. Prior to that date, he was for six years director of the Technological Laboratory of the Indian Central Cotton Committee, Bombay. He has also held the posts of head of the Experimental Fabrics Section of the Royal Aircraft Establishment and professor of textile technology in the Manchester College of Technology and in the University of Manchester. Dr. Turner takes up his duties at Lambeg, Northern Ireland, on September 1 next.

Fauna and Flora of the Low Countries

THE intense fighting over such a wide area of the Low Countries also threatens to damage fauna and flora of international interest, as in Norway (see NATURE of April 27, p. 663). In Holland there are well-known sanctuaries for seabirds that have attracted photographers from Britain for many years, and the Netherlands Society for the Protection of Birds has done much to preserve the breeding haunts. The sandy island of Texel near the Zuyder Zee is the breeding ground of many former British breeders which have now left their British nesting haunts. The black-tailed godwit is common on the polders, as are nesting ruffs at Wall en Burg polder, avocets, Kentish plovers, a few pairs of black tern nest, and of blue-headed wagtails, icterine and marsh-warblers, Montague's and marsh-harriers and spoonbills at the inland lake of Muy, garganey, short-eared owls and various commoner species. Texel is preserved under the State Forestry Commission. Another Dutch preserve, the Naardermere, has bitterns, ruffs, black terns and marsh-harriers. In winter the country is a great haunt of wild duck, and 140 duck decoys take 300,000 a year for the canning industry.

In Belgium, the Yser estuary is a reserve for waders, wild-fowl, etc., and there is another wild-fowl sanctuary near Nieuport. These were under the Ministry of Agriculture. Interesting experiments have been made with the successful introduction of the Scottish red grouse. The Flanders dunes have a very interesting flora, in many ways like that of the dunes of South Wales, western Lancashire or Norfolk. In the wet dunes and pools grow grass of Parnassus, round-leaved wintergreen, purple loosestrife, hemlock, storksbill, and on the dry ones, toadflax, bird's-foot trefoil, creeping willow, pink centaury, squinancy wort, burnet rose, Chinese box thorn, evening primrose, musk orchid, marsh helleborine, etc. The alien evening primrose on the Dutch dunes is associated with the important researches of de Vries and the doubling of chromosomes in *Œnothera Lamarckiana*. The famous Flanders poppies, increased by the calcareous nature of the soil following the bombardment of buildings in the War of 1914–18, had declined in numbers in recent years as the soil had returned to more normal type.

The Food Industry in War-time

In a lecture at the Royal Institution on May 21 in the series "The Nation's Larder", Dr. L. H. Lampitt, director and chief chemist of Messrs. J. Lyons and Co., Ltd., discussed "The Manufacture, Preservation and Distribution of Food". The food industry occupies a position between that of catering by households and catering of the canteen type. The economy to be effected by mass production is obvious because wastage is reduced to a minimum ; all waste products are taken and so treated that they have an economic value, labour is reduced and—a very important point—the amount of fuel consumed is considerably less. A striking example is in the baking of cakes. An ordinary gas cooker as operated by a housewife consumes approximately 10 cub. ft. of gas for each lb. of cooked weight of cakes, assuming the housewife was making 4–5 lb. of mixed cakes. In the case of a travelling oven, producing thousands of cakes an hour, the consumption of gas for each lb. of cooked weight is about 1⅛ cub. ft. In the realm of the homely potato, the average housewife loses approximately 22 per cent in peeling and eyeing. In mass treatment, where peeling is carried out by mechanical means, the loss is only 11 per cent.

By far the greater proportion of the bread baked in Great Britain is produced by large mechanical bakeries, and it is not an easy task to change over plant producing loaves made from white flour to loaves made from brown flour. The utilization of edible products not previously generally used as food, or used in a different form, is comparatively simple. Examples are the *Ersatz* coffee of Germany made from roasted barley and the *Ersatz* tea made from mixed leaves and shoots. These make palatable drinks, but the effect on the body is not the same as the natural products. By complicated chemical reactions, oils of the paraffin type which are unabsorbed by the human organism can be transformed into edible fats, and this is probably being carried out in Germany to-day. The production of protein matter by the activity of specially selected strains of yeast was practised in Germany during the War of 1914–18, and factories for this purpose were in being last year.

The Differential Analyser

In the application of mathematics to many problems both of pure and of applied science, rate of change of a quantity is often related to the magnitude of that quantity itself. This situation is expressed formally by a 'differential equation'. The differential analyser, of which the first was designed and built at the Massachusetts Institute of Technology by Dr. V. Bush and his team, is a machine for evaluating by mechanical means the solutions of differential equations, and its main applications are to problems giving rise to such equations which cannot be solved by formal methods.

Prof. D. R. Hartree, professor of theoretical physics in the University of Manchester, described the principles and applications of such a machine in his Friday evening discourse at the Royal Institution on May 17. The machine consists essentially of a number of integrating units each of which is a precision form of continuously variable gear. These units can be interconnected in various ways by shafts and gearing so as to form a translation into mechanical terms of the differential equation to be solved. There is also a number of 'input tables' from each of which information, in the form of a graph expressing the relation between two of the variables in the equation, can be supplied to the machine, and means of recording the solution of the equation either in graphical or numerical form ; there are also adding units each of which can form the sum of two terms in the equation. There are at present seven full-size machines of this kind in operation, and also in Great Britain, several small-scale ones, some built mainly of standard Meccano parts, and others workshop-built. It may be recalled that the differential analyser at Manchester was described by Prof. Hartree in NATURE of June 8, 1935, p. 940.

Summer School in Social Biology

The Educational Advisory Board of the British Social Hygiene Council is arranging a Summer School for Teachers and Social Workers at Westminster College, Cambridge, during August 1–8. The main interest of the School will be focused upon a "School-Leavers' Course in Human Biology" which has recently been prepared by the Educational Advisory Board to assist in meeting the urgent problems that have arisen affecting adolescents as a result of war conditions. Various aspects of the syllabus will be presented in the form of symposia, contributed to jointly by distinguished biologists and practising school teachers. These symposia and the ensuing discussions should be of considerable value in helping participating teachers to a deeper understanding of the natural endowments of their pupils. Another section of the School will deal with some of the problems in social biology which to-day have become a matter of vital concern for the peoples of the British Empire.

Prof. J. C. Ryle, regius professor of physic in the University of Cambridge, will be president of the School, and Mr. L. J. F. Brimble will be director.

The inaugural address will be delivered by Sir Walter Langdon-Brown, emeritus professor of physic in the University of Cambridge. The following speakers have undertaken to give lectures and take part in discussions: Prof. J. C. Drummond, scientific advisor, Ministry of Food; Dr. Leslie J. Harris, director of the Nutritional Laboratory, University of Cambridge; Dr. Grace Calver, physician, Children's Department, Tavistock Clinic; Mrs. C. Neville-Rolfe, past vice-president, Eugenics Society; Sir Drummond Shiels, medical secretary, British Social Hygiene Council; Mrs. E. J. Hatfield, North London Collegiate School; Mr. R. Weatherall, Eton College; and Miss V. D. Swaisland, British Social Hygiene Council. Further information can be obtained from the Education Officer, British Social Hygiene Council, Inc., Tavistock House South, Tavistock Square, London, W.C.1.

International Relief Union

THE origin, aims, means and future of the International Relief Union are discussed by M. Camille Gorgé in a pamphlet recently issued by the Union (Geneva: International Relief Union). M. Gorgé points out that, for good or for ill, the States of the world have become so closely welded together that they form a great family from which no one member can dissociate himself without serious inconvenience or actual hardship. Although international co-operation has at present lost most of its vitality and force, sooner or later the nations must revert to the method of collective agreements, and use the instruments or machinery already established for that purpose. The International Relief Union, which was established by the Convention of July 12, 1927, was largely the outcome of a scheme elaborated by M. Giovanni Ciraolo to provide not only for immediate and organized relief for peoples overtaken by disasters, such as earthquakes or other catastrophes arising from natural causes, epidemics, famine, etc., but also for the scientific study of the causes of natural calamities, with the view of counteracting or limiting their effects. According to the Convention, the International Relief Union has a fourfold task: it must furnish first aid to the populations that are victims of public disasters, and co-ordinate, as occasion offers, the efforts made by other relief organizations; it must also encourage the study of preventive measures against disasters and seek to induce all peoples to render mutual international assistance.

The Convention did not come into force until December 27, 1932, and its financial resources were too limited for it to do its work freely and effectively. Special stress is laid upon the mobilization of the forces of good will against adversity beyond national frontiers, and upon encouraging scientific men to study how to combat or even counteract future disasters. Scientific workers are urged to co-ordinate research in all its branches so that the various communities may unite their concrete efforts, based on accurate data, to minimize the damage to the human family caused by great scourges. Aviation and broadcasting have already done something to reduce the gravity of certain disasters, and fresh opportunities of foresight and defence continually arise. To assist scientific workers to explain their ideas and compare results in this field, the Union in June 1938 issued the *Revue pour l'étude des calamities*, replacing the *Matériaux pour l'étude des calamities*, previously published by M. Montandon in collaboration with the Société de Géographie de Genève. One of the first tasks of the Union in this field is to make a detailed study of the geography of natural disasters. A resolution of the first International Conference for Protection against Disasters, Paris, September 1937, recommended that the Union should consider the appointment of a Permanent International Committee for Protection against Disasters, collaborating with the Board of Scientific Documentation of the Union, and M. Gorgé briefly indicates directions in which such concerted scientific effort is required.

Wood Pole Transmission Lines

IN order to examine the incidence of risks from shocks and fire due to the use of wood-pole transmission lines, tests were undertaken of primary insulation at 19, 11 and 6·35 kv. The work is described by G. T. Garwood in the *Electrical Review* of April 12. The structure on which the tests were carried out comprised a plain-sawn English oak cross-arm, 5 in. by 3 in., bolted to a red fir-pole, 32 ft. by 11¼ in. in diameter at 5 ft. from the butt. The pole was sound in every way and had been creosoted. The instruments used for the tests were two electrostatic voltmeters. The resistance between the cross-arm bolt and earth was measured on frequent occasions in the period during which the test was being taken and also under varying conditions of dryness. The megger readings ranged from 200,000 ohms with the pole dry to 50,000 ohms with it wet. With the 11 kv. connexions a current of 140 micro-amperes could be obtained from below a plain earthing collar. As 15 micro-amperes may give a fatal shock to a normal man, if his heart lie in the circuit, the experiments showed that a plain earthing collar round the pole is insufficient protection. In the destruction tests, about ten minutes after the wetting of the pole smoke appeared from the cross-arm near the insulator pin. Longitudinal 'shakes' opened up in the cross-arm and showed signs of carbonizing. After about twenty minutes, smoke appeared from these shakes, the source of the smoke moving steadily towards the pole. After thirty minutes, smoke appeared from the pole top and 'tracking' with small intermittent flames at the earthing collar. Heavy smoke and flames appeared at the pole-top after seventy-five minutes and after eighty-five minutes the test was stopped, it being clear that the complete destruction of the structure was inevitable.

Flavour of Bacon

THE Department of Scientific and Industrial Research has issued a report describing work carried out for the Food Investigation Board on the importance of various factors responsible for the pro-

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NATURE

SUPPLEMENT

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SHORT REVIEWS

ANTHROPOLOGY AND ARCHÆOLOGY

The Discovery of Man

The Story of the Inquiry into Human Origins. By Stanley Casson. Pp. 340+16 plates. (London: Hamish Hamilton, Ltd., 1939.) 12*s.* 6*d.* net.

IT is remarkable, but none the less true, as Mr. Casson points out, that in the order of the development of the sciences man comes last to the most fascinating study of all—the study of himself. It is further notable that the study of man, affording so many avenues of approach, has so frequently, but no doubt inevitably, advanced by the investigation of what may be regarded as side issues. This appears here in the author's references to early developments in ancient and classical Greece, where, for example, the collection of ethnographical and geographical data was an outcome of the needs of navigation and commerce; and if history as conceived in the theory of Herodotus demanded a basis of ethnography, Thucydides turned no less to a line of investigation which was in effect archæological research.

Mr. Casson's entertaining and informative narrative follows the development of the various branches of anthropological inquiry through classical and medieval times and the Renaissance down to modern times. His wide acquaintance with the less-known paths of classical and post-classical literature has enabled him to record much that will be both new and of value to those who are interested in the earlier phases of scientific modes of thought. Coming to modern times, as an archæologist who himself has worked in the field, he is able to survey the record of workers in the various regions of the Mediterranean and the Near and Middle East with a firm grasp of the trend of discovery as a whole, and at the same time a just appreciation of the contribution of each individual investigator in the major fields of discovery.

On the ethnographical side, and in what is now termed cultural anthropology, Mr. Casson is not, it must be admitted, equally well equipped, nor in consequence is his record so complete, especially when he deals with the descriptive and comparative studies in religion and law of English and French writers of the late sixteenth and the seventeenth centuries and the French compendia of races of the early eighteenth century, which led up to Montesquieu.

Escape with me! an Oriental Sketch-Book

By Osbert Sitwell. Pp. xv+340+16 plates. (London: Macmillan and Co., Ltd., 1940.) 12*s.* 6*d.* net.

IT is always of interest to the archæologist to note the reactions of others to the material in which he himself works. If they have the trained eye of the observer of men and cities, a sense of æsthetic values, combined with a gift of literary expression, he may hope to recapture from their observations something of the nature of the general complex of the culture as a whole which it is his purpose to recover from the evidence of the past, but which his preoccupation with details of research too often precludes him from viewing in true perspective. No one assuredly who desires a scientifically accurate account of Angkor or Peking would consult Mr. Sitwell's "Escape with Me" as a first-hand authority, yet from his vivid pen pictures of the line, mass and colour of the great complex of temple monuments at Angkor and his obvious sympathy with Eastern modes of life and thought, especially as lived in Peking, it is possible that the reader may attain a truer understanding than from more solid treatises in the archæological or historical sense.

It must not be imagined, however, that Mr. Sitwell's book, frankly escapist, is the fruit of hurried impression. Some months were spent by him in Peking, his contacts with the Chinese were as intimate as the circumstances allowed; and he made full use of Bodde's translation of "Annual Customs and Festivals of Peking" and Arlington and Lewissohn's "In Search of Old Peking", with results no less pleasing to the reader than gratifying to himself. Thereby in effect he was led to a judgment of Chinese culture and character in relation to current events or which there is much to be said.

BIOLOGY

Textbook of Biology

By Dr. E. R. Spratt and A. V. Spratt. Second edition. Pp. viii+692. (London: University Tutorial Press, Ltd., 1939.) 11*s*. 6*d*.

IN preparing the second edition of this work, the authors have completely revised the original text and figures and have added two new chapters dealing with Pinus and Angiosperms to meet the requirements of the Pharmaceutical Society's examinations. The material presented is intended to cater for students pursuing courses in biology for the intermediate science, pharmacy, and medical examinations of Great Britain, the higher school certificate, the preliminary medical, and other examinations of a similar standard. The greater part of the book is concerned with minute descriptions of the anatomical mechanisms of the plant and animal types met with in these various examination syllabuses. This is followed by a smaller physiological section, which is chiefly concerned with plants, and a chapter on ecology. The laws of heredity and evolution are summarily treated, while the appendix contains useful practical hints. The book is admirably illustrated with a considerable number of clear diagrams. Inaccuracies of the previous edition have been largely eliminated, although it is a little disconcerting still to read that Pellia "is branched to form many lobes, thus reminding us somewhat of the liver of an animal and giving the plant the name liverwort".

This is indeed a text-book and would only be of use as a source, and perhaps better, revision book for the examinations mentioned above. T. H. H.

A Naturalist on Rona

Essays of a Biologist in Isolation. By Dr. F. Fraser Darling. Pp. x+138+28 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 7*s*. 6*d*. net.

DR. FRASER DARLING'S sojourn on the isolated island of Rona has repaid its hazards, since it gave him the opportunity of writing these essays as well as of observing that unique seal rookery during the breeding season. Many subjects are touched upon in the eight essays, ranging from the archæology of the primitive chapel and cell of St. Ronan, which the author partially restored, to display of birds, social life of animals, animal sanctuaries, and an excellent account of the habits of the grey seal. The essays are vivid in their description, are attractively written and are illustrated by some beautiful photographs. If occasional inaccuracies creep in they are not serious. For example, in his strong plea for the creation of sanctuaries in Great Britain, the statement that "before Theodore Roosevelt's time a few people had thought, rather ineffectually, about the protection of wild life", takes little account of the facts that Congress had set aside the Hot Springs Reservation in 1832, that the Yellowstone National Park was established in 1872, and that the American Ornithologist's Union had its law for the protection of wild birds in 1886, quite apart from much effective legislation in other countries.

A Catalogue of Yorkshire Fungi

By the late F. A. Mason. Completed from the Records of the late Alfred Clarke by Dr. John Grainger. Pp. xii+110. (London and Hull: A. Brown and Sons, Ltd., 1937.) 7*s*. 6*d*. net.

THIS Catalogue of Yorkshire Fungi (Limited Edition) is essentially an extension of Messrs. Massee and Crossland's "Mycological Flora" (1905), which attempts to bring up to date those records, supplemented from forays and individual efforts.

The new volume adds about 835 species and varieties, chiefly in the Basidiomycetes (660) and the Ascomycetes (110) sections. The × and — method of recording is unsatisfactory as it signifies the mere presence or absence of the species in an area of usually more than 1,000 square miles with no indication of frequency or otherwise, so that the old Flora will still be the only reference book giving both species and localities.

Apart from the above and a dateless title-page, the chief fault of the work is its omissions, primarily of sources: thus many species and V.C. records are absent, for example, August 1934 Goole district records have been placed in the East and not West Riding, no mention of Entomophthoraceæ for the East Riding, although seven of these species were listed in the *B.M.S. Transactions* 1932; while *Cordyceps entomorrhiza* is a misnomer for *Cordyceps gracilis*.

The Mycological Committee has reviewed the work and decided to publish amendments in the *Yorkshire Naturalist* that will greatly add to its utility.

J. W. HAIGH JOHNSON.

Tertiary Siphoneous Algæ in the W. K. Parker Collection, with Descriptions of some Eocene Siphoneæ from England

By Lucien and Jean Morellet. Pp. ix+55+6 plates. (London: British Museum (Natural History), 1939.) 5*s*.

CALCAREOUS green algæ (of the Siphonales) are now almost confined to warm seas, but fossil representatives are being discovered widely. This catalogue describes an important series of specimens from a well-known Eocene locality in France, and for the first time some similar ones from England. The study of these fossils has required very close observation of minute specimens (the present collection had been classed as Foraminifera), bold hypothesis and good luck; this last is seen here for Ovulites. This common fossil was known as little shells shaped like a blown bird's egg. Specimens have now been described in which a chain of these are still held in position by the continuous skeleton of an encrusting Bryozoan; the new specimens show that Ovulites is very like the existing alga Penicillus.

The large number of specimens mentioned as *Incertæ sedis* indicate room for further study and further good luck. TOM M. HARRIS.

Bats

By Glover Morrill Allen. Pp. x+368+31 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 17*s*. net.

THIS book is full of information of value to those specializing in the study of bats; but it is written for the general reader. It seems scarcely possible that anyone except a bat-specialist would want to know so many details about bats, and the innumerable names of different species can mean almost nothing to those who have not made a special study of the group. The biologist with special interest in the Chiroptera will find this a really valuable book written by an enthusiast, but will probably skip the unnecessarily large part devoted to popular superstitions about the order. The same amount of space could more profitably have been devoted to classification, which is scarcely touched upon. Many of the photographs are good. A large and useful bibliography is given.

Ce qu'il faut savoir des insectes

Par G. Portevin. Vol. 2: Coléoptères et hémiptères. (Savoir en histoire naturelle, Vol. 3.) Pp. 308+14 plates. (Paris: Paul Lechevalier, 1939.) 40 francs.

THIS is an excellent low-priced guide to the orders Coleoptera and Hemiptera. It is primarily a pocket manual designed to aid in the recognition of the chief members and, for this purpose, there are numerous keys to families and genera together with notes on some of the more characteristic species. The text-figures are clear and accurate and the plates are good.

CHEMISTRY

Reports of the Biochemical Research Foundation of the Franklin Institute

Vol. 5, 1938–1939. Pp. vii+42 papers. (Philadelphia: Franklin Institute, 1940.)

THIS collection of stimulating scientific publications shows how diverse biochemical techniques, recently discovered in various parts of the world, can be used to supplement one another in the elucidation of particular problems in the attack on disease. Thus in the chemical and microchemical sections the manometric respirometer methods of Warburg and of the Cambridge school together with the Linderstrøm-Lang microtechniques are used to study metabolic and enzymic activities of tissues. The cyclotron is used for the production of radioactive elements which can afterwards be introduced into compounds of biochemical interest, for example, glutathione containing radioactive sulphur. In the physico-chemical and immunological departments, purification and analysis of therapeutic serum antibodies are carried out by the Svedberg ultracentrifuge, and the electrophoretic technique of Tiselius is applied to studies on antibodies from allergic sera.

The Biochemical Research Foundation, which was formerly known as the Cancer Research Laboratories, has now a wider outlook on disease. Its aims are: (1) the study of disease from a chemical point of view; (2) the study of new compounds for their therapeutic and beneficent effects; and (3) the study of age and the diseases of age. Such problems are attacked from their fundamental basis. For example, pancreatic hormones having blood pressure lowering action and their isolation, one of the many lines of research undertaken by the Foundation, may seem to have little to do with the ageing process, but substances which reduce blood pressure, an age manifestation, have a great deal to do with it.

Theoretical and Applied Electrochemistry

By Prof. Maurice de Kay Thompson. Third edition. Pp. xxi+535. (New York: The Macmillan Company, 1939.) 22*s*. net.

THE new edition of this excellent book is entirely re-written, but it preserves all the valuable features of preceding issues. The first part is a compact treatise on modern theoretical electrochemistry which, on account of the concise style, covers all the important branches in a comprehensive and satisfactory way. The second and third parts deal with the applied electrochemistry of aqueous solutions, and with electric furnaces and their products, respectively, and here again the treatment is comprehensive and accurate. The amount of information contained in the book is surprising, and no important branches of the subject seem to have been missed. The literature references are very complete, and the illustrations are clear and well chosen. A particularly valuable feature is the large number of problems and exercises, for which not only answers but also concise solutions are provided. This is a thoroughly satisfactory book, and the author deserves high praise for the skilful and expert way in which he has brought the material together and for the clear and accurate presentation of it.

GEOGRAPHY AND TRAVEL

This Way Southward

The Account of a Journey through Patagonia and Tierra del Fuego. By A. F. Tschiffely. Pp. xvi+354+50 plates. (London and Toronto: William Heinemann, Ltd., 1940.) 15*s*. net.

MR. TSCHIFFELY, who had already won a well-deserved reputation as an adventurous traveller in the Americas on horseback, here records the events of another one-man expedition, though in this instance by car. From Buenos Aires he drove down the Atlantic coast of Patagonia to Tierra del Fuego and thence back to Buenos Aires along the western side of the continent by way of the Andes and across the continent. In all, 7,000 miles were covered, the return journey along the Andes involving a number of detours to avoid country unsuitable for the car. This was, indeed, the most difficult part of the journey, and frequently skirted country which is not only unexplored but also probably unexplorable except by air.

On the outward journey the author visited the famous Welsh colony founded in the middle of the last century, in which in the younger generation knowledge of English has almost completely disappeared. His description of a country which has nothing to offer in the way of the picturesque is none the less of considerable interest in view of the economic development of a territory once regarded as an arid waste. If the outward journey was not without its incidents, the return, starting from the embarkation on the ice-encircled Lake Argentino, provided them in plenty, and from this point also Mr. Tschiffely is able to incorporate in his narrative episodes from the history of the country, beginning with the Conquistadores and the search for El Dorado down to the ill-fated attempt to develop sheep-farming on the Rio Baker. In describing what he saw of Tierra del Fuego the author tells his readers something of the Yahgan and Ona Indians, not as they are now, but as they were at the beginning of the century, his information being derived from Mr. Lucas Bridges, "the only living authority". His own experiences among the Tehuelche Indians, now mostly 'civilized', included visits to some of those who still live in primitive 'tent-villages', but whose life is sadly circumscribed by the loss of freedom of the land.

The Wandering Lake

By Sven Hedin. Translated from the Swedish by F. H. Lyon. Pp. x+293+30 plates. (London: George Routledge and Sons, Ltd., 1940.) 18*s*. net.

"THE Wandering Lake", originally published in Swedish, is the third volume which Dr. Sven Hedin has devoted for the benefit of a non-technical public to the activities of the members of his great expedition to Central Asia. On this occasion he deals with the explorations carried out in 1934, of which the most important from the scientific point of view was the examination of the conditions accompanying and arising out of the change in the drainage of the Tarim Basin, which took place in 1921. In that year the waters draining into Lake Kara Koshan were diverted into an ancient watercourse, the Kum-daria, in which water had not flowed for some sixteen hundred years, to form a lake in the Lop-nor depression. Kara Koshan, discovered by Prjevalsky in 1876–77 and identified by him with the ancient Lop-nor, is now becoming desiccated.

The dry ancient watercourse of the Kum-daria had already been traversed by Dr. Sven Hedin at the beginning of the century, when he discovered the ruined city of Lou-lan, and on the basis of his observations of physiographic conditions, ventured to put forward a hypothesis as to the position of the ancient Lop-nor and the physical conditions making it a wandering lake, which the course of events would now appear fully to justify.

Three years before the journey recorded in this volume, two members of the expedition had explored the delta of the Kum-daria where it enters the lake. Here the author records the events of a journey made by canoe with the object of ascertaining how far the stream was navigable. The story is told with the meticulous attention to detail to be expected from the author, and includes a graphic picture of the lake—a remarkable body of water both in size and character.

MATHEMATICAL AND PHYSICAL SCIENCES

An Introduction to the Calculus

By Prof. K. R. Gungikar. Pp. xiv+341. (London: Oxford University Press, 1938.) 4 rupees.

THIS little volume has been designed as a first course in the calculus for Indian students. The treatment is the outcome of years of experiment and observation and the method followed is, as the author points out, rigorous in the long run. By this is implied that the refinements of modern rigour are gradually developed, as they should be, in accord with the fundamental principles of true teaching. This idea, which is not too frequently apparent in mathematical text-books, as distinct from those written especially for schools, has been well and consistently carried out. After a commendable foreword to the student, twelve instructive chapters follow which should ensure a firm foundation for future study of the calculus. Beginning with limits and continuity, occupying three chapters, the student is led to the derivative itself. The usual standard theorems concerning the differentiation of functions are then considered, together with second order derivatives, maxima, minima and the exponential and logarithmic functions. Integration is next introduced as the inverse of differentiation, its full significance being developed later in accordance with the aim of the writer. The final chapter, after summarizing a few of the more important standard results previously established, proceeds to discuss briefly Taylor's and Maclaurin's series, Rolle's theorem, partial fractions, hyperbolic functions and surface and volume integrals.

The text has been well written and is not only sound but also designed to stimulate the reader's interest. It is excellently illustrated with fully worked-out practical examples as well as with clearly drawn diagrams. Each chapter closes with an appropriate set of exercises for the student, and answers to these are supplied. The book should prove very useful to all mathematical students of this essentially practical subject.

Geometrische Kristallographie und Kristalloptik und deren Arbeitsmethoden

Eine Einführung. Von Dr. Franz Raaz und Dr. Hermann Tertsch. Pp. ix+215. (Wien und Berlin: Julius Springer, 1939.) 18.60 gold marks.

THIS book is suitable for students engaged in a systematic course of formal and optical crystallography corresponding roughly to Part 1 of the Natural Sciences Tripos at Cambridge in those subjects. All the usual and essential features are included, and an introduction to the manipulation of the Von Federow universal stage will be appreciated by the more advanced worker. The knotty question of the real significance of conoscopic illumination is very ably handled, with a clear diagram to correspond.

Whilst nothing very new is to be found in these pages, the reader will probably benefit by using this volume, mainly because the authors present their matter well, and incidentally by reason of the good practice which is obtained by following a well-known theme in a foreign language.

F. I. G. R.

MEDICAL SCIENCES

Medical Microbiology

By Prof. Kenneth L. Burdon. Pp. xii+763. (New York: The Macmillan Company, 1939.) 18*s*. 6*d*. net.

THIS work, which is intended both for students and their teachers, is divided into four parts and five appendixes. The first part, which deals with the fundamentals of microbiology, consists of sixteen chapters, including an account of the historical aspects of the subject, the various types of micro-organisms, their classification and nomenclature, and their destruction by physical and chemical methods. The second part is concerned with the laboratory study of micro-organisms, and gives a description of the apparatus, culture media, isolation of bacteria and the collection of specimens for bacteriological examination. In the third part, which deals with infection and resistance, sources of infection, modes of spread by water, milk and other foods, the part played by insects, natural and acquired immunity, vaccine and serum therapy, and anaphylaxis receive attention. In the fourth part the microbiology of important infectious diseases is studied, including tetanus, diphtheria, pneumonia, typhoid and paratyphoid fever, staphylococcus and streptococcus infections, etc. The appendixes are devoted to a comparison of metric and English scales, formulæ for the preparation of media, reagents and stains, important immunological tests, classified lists of references, and questions to which the answers will be found in the foregoing pages.

This comprehensive work, which is liberally illustrated, will form a useful handbook for the laboratory worker and clinician alike.

Epidemiology in Country Practice

By Dr. William Norman Pickles. Pp. viii+110+1 plate. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1939.) 7*s*. 6*d*. net.

THE author, who is medical officer of health to the Aysgarth rural district in Yorkshire, is introduced in the preface by Prof. Major Greenwood in allusion to the Bristol physician and epidemiologist as "a second Budd", which, as the reader will find, is a high, but well-merited, compliment. Dr. Pickles not only appeals to other country doctors to keep records, as he has done for many years, of epidemic diseases, but also seeks to awaken the interest of the layman, whose help in this field he regards as inestimable. The work, which is remarkably readable, consists of a number of essays, some of which have already been published in various medical journals, dealing with certain common infectious diseases, such as influenza, measles, scarlet fever, whooping-cough, mumps and chicken-pox, as well as less common infections, such as Sonne dysentery, pink disease, undulant fever, epidemic catarrhal jaundice, and the disease variously known as epidemic myalgia, Bornholm disease or devil's grip, the occurrence of which in Great Britain was first described by Dr. Pickles.

Diet in Health and Disease

Edited by Sir Humphry Rolleston and Dr. Alan A. Moncrieff. (Published on behalf of the *Practitioner*.) Pp. 382. (London: Eyre and Spottiswoode, Ltd., 1939.) 14*s*. net.

MORE than thirty years have elapsed since the appearance of the last important British compendium on diet, edited by the late Dr. G. A. Sutherland, so that a new book on the subject was urgently needed. Most of the articles in the work have already been published in the *Practitioner*, but they have been revised and a few new ones have been added. The book contains twenty-eight chapters contributed by thirty-two specialists. The chapters on diet in health deal with the various forms of infant feeding, diet in childhood, old age, winter and summer, pregnancy and lactation, and in the tropics, while the chapters on diet in disease are concerned with sick-room menus and recipes, diseases of the various systems and allergic diseases. A special chapter is devoted to alcohol, the dietetic use of which has been greatly reduced in recent years. The up-to-date and practical advice in which the work abounds will render it a useful handbook to the practitioner and student.

The Handicap of Deafness

By Irene R. Ewing and Dr. Alex. W. G. Ewing. Pp. x+328+3 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 12*s*. 6*d*. net.

THIS book contains a unique record of experience in a particularly arduous field of social science, and is likely indeed to fulfil the aims of its authors to provide a working source of information alike for the deaf and those who serve them. The difficulties which beset the management of the deaf are dealt with in a manner connoting wide knowledge and technical competence, and the lessons to be learned are both valuable and clearly defined. Particularly striking are the figures showing the time wasted in chronic deafness in adults before the initiation of lip reading, its importance in reinforcing any hearing aid, and the high percentage of deafened adults who can be considerably assisted by modern electrical apparatus.

The sections dealing with the measurement of deafness are eminently sound. Intelligibility of speech is very properly made the basic test, and the reviewer particularly welcomes the emphasis laid upon the necessity in such tests of excluding the influence of context. The method adopted of nonsense syllables is probably the best available, but more emphasis might have been laid upon the necessity for highly trained personnel for its successful application; and there seems little reason why this in its turn should not in due course be placed upon an electrical basis. Some lack of accord between pure tone threshold tests and intelligibility in the earlier stages of deafness is recognized and accords with the more empirical observations of clinicians. One of the best chapters is that which describes deafness and its recognition in the young child. The influence of Mr. T. S. Littler's technical contributions is apparent throughout this book and is frequently acknowledged by its authors. C. S. H.

Biography of the Unborn

By Margaret Shea Gilbert. Pp. x+132. (London: John Murray, 1939.) 5*s.* net.

THIS little book surveys in simple language the development of the human embryo during its nine months of intra-uterine life. Fertilization, the role of the sex chromosomes, the genesis of twins and the occurrence of malformations are also briefly dealt with. The descriptions are illustrated with numerous diagrams which clearly depict the changes that occur as growth proceeds from month to month.

The book gives an accurate summary of the subject, but is scarcely advanced enough or sufficiently scientific for the student or medical practitioner. For the layman who is interested in the subject, and for whom it is primarily intended, it can be recommended.

METALLURGY

Metallurgy for Engineers

By E. C. Rollason. Pp. viii+272. (London: Edward Arnold and Co., 1939.) 10*s.* net.

NO words are wasted in this book, the purchaser of which receives about seven hundred per penny, together with some 150 illustrations, including many clever diagrams which amplify the text. Here indeed is value for money which no student can readily ignore. The most serious criticism which can be made of the book is that it is too concise and may encourage 'cramming'. Although the preface indicates that the book is intended for use in conjunction with a teacher, this does not absolve the author from responsibility, and one would like to see, in the next edition, fewer statements of fact and more explanations of basic principles.

Practical Microscopical Metallography

By Dr. Richard Henry Greaves and Harold Wrighton. Third edition, revised and enlarged. Pp. xi+272+60 plates. (London: Chapman and Hall, Ltd., 1939.) 18*s.* net.

A DISTINGUISHED research metallurgist collaborated with a virtuoso of the metallographic microscope to produce, in 1924, the first edition of this book. It has become the standard work on the subject, and one turns from the second edition with a tinge of regret, to greet the new friend. The authors still refuse to call it a text-book, although it is far more than a series of annotated photomicrographs. Many of these are, as in the previous editions, superb, and most of them are excellent: one or two permit the average metallographer to regain his self-respect, at least for a moment. The descriptions of technique are even more extensive and the practical hints on low-power work are particularly welcome. Discussion of the 'austemper' process, photomicrographs of typical disintegration-proof 18-8 steels, and particulars of the electrolytic cyanide etch for precipitated carbides, might be included with advantage in the next edition.

MISCELLANY

The Growth of Science

An Outline History. By A. P. Rossiter. (Published for the Orthological Institute.) Pp. 372. (London: Sir Isaac Pitman and Sons, Ltd., 1939.) 5*s.* net.

THIS little book will prove very useful from many points of view. It gives an authoritative account of the leading stages of the history of science. Then it connects the various fields of science in a way which helps the reader to understand the unity of its development. Moreover, it gives a short explanation of the notions involved in the problems discussed. Finally, it gives a good illustration of what can be done in this field by a judicious use of Basic English. Controversial issues are wisely avoided; and as the book is short, one feels less the monotony of the basic vocabulary and syntax ably used by the author. In itself, this work is an excellent popular introduction to the history of science.

The Language of Gesture

By Dr. Macdonald Critchley. Pp. 128. (London: Edward Arnold and Co., 1939.) 5*s.* net.

AS students of human speech still concentrate primarily on its sounds rather than on the muscular movements which produce them, it is well that specialists like Dr. Macdonald Critchley should intervene. He has brought together, in 124 pages, a larger volume of valuable material than has so far been available. It is surprising, however, that though the author pays great attention to gesture language—including copious references to the scattered literature on the subject—he does not mention Darwin's observation on the sympathy of movement between man's hand and mouth, which constitutes the fundamental link between primitive descriptive gesture and the significant mouth movements of speech. Nor does he clearly define the difference between instinctive pantomime—such as that of the born deaf—which describes events as a whole, and the acquired sign languages—such as that of the Red Indians—in which each sign stands for a separate unit of thought, equivalent to a 'word'. The origin of these units of thought deserves thorough investigation.

The reference to Armenian sign language (p. 50) needs correction. The language is used exclusively by women—not by men. The descriptions of hand gestures might have been made easier; "pronated", "adducted", etc., will be unfamiliar terms to many of the wide public by whom this excellent little book should be read.

Land Drainage and Reclamation

By Prof. Quincy Claude Ayres and Prof. Daniels Scoates. (McGraw-Hill Publications in Agricultural Engineering.) Second edition. Pp. xi+496. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 26*s*.

THIS work is of the nature of a text-book and as such is particularly designed for American State colleges, in that the usual problems associated with each subject are asked at the end of each chapter. Survey with levelling is taught and then the technique of drawing, the open ditch method and the use of earth dams being especially carefully explained. Land clearing by grazing, cutting and burning encourages soil erosion which has to be controlled. This leads to the consideration of the terracing of fields and the use of check dams in gullies. Finally, sub-surface draining is considered, and the use of mechanical means in the cutting of the necessary trenches for drain pipes. Where there are wide areas of similar land as in Iowa and Texas the methods recommended can be applied. In Great Britain, with its much greater variation in topography and geology, this book will only be helpful in suggesting methods, the consideration of the drainage of each farm being a little research of its own.

Begin Here

A War-Time Essay. By Dorothy L. Sayers. Pp. 160. (London: Victor Gollancz, Ltd., 1940.) 6*s*. net.

MISS DOROTHY L. SAYERS, for the moment breaking free from her pre-occupations with the writing of detective stories and the drama, has presented her numerous public with a War-time essay. Her somewhat cryptic title expresses her firm conviction that now and not the end of the War is the time for pondering and planning the post-War world in which we are to emerge from the present struggle. Her vigorous call for constructive thinking on the part of the average citizen for whom she writes is based, as befits so informed a student of the medieval world, upon an acute analysis of the main currents of thought and emotion which contributed to making Europe of the Middle Ages something of a homogeneous whole. Possibly there is a tendency in a certain group of writers on historical topics to overstress this unity. Be that as it may, Miss Sayers recognizes that the revival of learning and the growth of the spirit of inquiry made impossible a return to that unity of thought and emotion, with all its implications as a condition of peaceful relations among the people of Europe. It is the business of constructive thinking to arrive at a form of relation in modern civilization which in like manner will bring about not a static, but a dynamic, condition of peace. Miss Sayers is emphatic in pointing out that this is to be achieved not by consideration of the requirements of 'economic man' or psychological considerations but only of the whole nature of man in which the part of emotion as well as reason attains free play.

Uses of Lac

By Dr. H. K. Sen and S. Ranganathan. Pp. 79+20 plates. (Namkum: Indian Lac Research Institute, 1939.) 1.4 rupees.

THIS little book is intended primarily to interest Indian manufacturers and industrialists as potential users of lac and shellac. The authors point out that since the consumption of lac in India is only 2–3 per cent of the exported amount, there should be considerable room for expansion in that country. The book, however, should have a definite appeal to the average reader, seeking knowledge of the origin and uses of this unique natural resin. Many of the more important applications of this raw material are briefly described and there are numerous practical recipes.

Among the large amount of data given, the table (p. 15) showing the export figures for the past twenty years is of particular interest inasmuch as it demonstrates that lac is more than holding its own in face of competitive synthetic resins.

The book is attractively printed with well-defined headings and sections, and amply illustrated by numerous photographs showing the diverse uses of shellac and its commercial products. The clarity of some of the illustrations, however, appears to have suffered in reproduction.

PHILOSOPHY AND PSYCHOLOGY

The Structure of Aristotelian Logic

By Prof. James Wilkinson Miller. (Psyche Monographs, No. 11.) Pp. 97. (London: Kegan Paul and Co., Ltd., 1938.) 10*s*. 6*d*. net.

THE principal aim of this able book is to effect the reorganizations required in traditional logic by the introduction of negative terms, which occurred technically during last century; and also to give a rigorous presentation of traditional logic as containing negative terms.

The former analysis of Aristotelian logic given by the author introduces new definitions, postulates and distinctions necessitated by the symbolization of the system. This formalization makes traditional logic look much poorer than the so-called recent generalizations of the subject. It could scarcely be otherwise; for this treatment of the Aristotelian system takes, so to speak, all the blood out of it. It is not its mere formalization that gives an inferential necessity to this system; but also and mainly its ontological and qualitative background. One without the other gives an unfair picture of traditional logic, especially as the author of the book assumes without proof that the fundamental principles of Aristotelian logic are less general than those of modern mathematical logic. As it is, however, the book should help to build up a more satisfactory valuation of Aristotelian logic, provided one takes into account most of the relevant subjects which the author omits deliberately in his discussion.

Cosmology

A Text for Colleges. By Prof. J. A. McWilliams. Second revised edition. Pp. x+243. (New York: The Macmillan Company, 1938.) 9*s*. net.

To many readers this book will seem old-fashioned, with little reference to the technical problems which face the modern scientific worker. For one thing, the bibliographies given at the end of each chapter and at the end of the book show a complete disregard of the recent technical literature by leading specialists on mathematical and physical theory. Father McWilliams approaches his problems from a scholastic angle. But there is no reason for giving the impression that scholasticism is necessarily backward.

Many readers would be interested to know how the fundamental ontological and cosmological theories of scholasticism can be interpreted in terms of modern scientific discoveries; and this interpretation is, no doubt, possible. This book, however, is valuable in suggesting such an approach, provided one could go much further than the elementary details it takes into account. The argumentative method adopted is also refreshing. As to the controversial issues involved, the author repeats the classical solutions, where he could use, with greater effect, examples and arguments from recent scientific discoveries.

PHYSIOLOGY

Nahrung und Ernährung

Altbekanntes und Neuerforschtes vom Essen. Von Dr. Hans Glatzel. (Verständliche Wissenschaft, Band 39.) Pp. vii+256. (Berlin: Julius Springer, 1939.) 4.80 gold marks.

The author of this book set himself the task of presenting the elements of the science of nutrition in a manner which would make them intelligible to every German citizen. An introductory section discusses food and nutrition in the animal kingdom and the physiological basis of nutrition. Dr. Glatzel then considers the composition and distribution of the foodstuffs within the Third Reich and the effective methods of conditioning, preserving and cooking. The role of the sense-organs in digestion is adequately described and, in the treatment of the hygiene of eating, the author takes great pains to emphasize the distinction between hunger and appetite. In dealing with food-requirements and the variations, the effectiveness of the Allied blockade in 1914–18 receives considerable prominence, indications being made to suggest that such a condition can never again be possible in Germany. Particular food-fads and dietetic methods are examined and, where necessary, exposed. In an excellent chapter the author discusses the significance of food and nutrition in myth and religion. In conclusion, nutrition is related to the social problem, due regard being paid to the organization of Germany's food economy. The real purpose of the book is revealed in its last sentence: "Von den Nahrungs-wahl jedes einzelnen, von seinem gutem Willen und seiner Einsicht hängt es aber auch ab, wie schnell und wie vollständig wir das grosse Ziel erreichen: *Deutschlands Nahrungsfreiheit*."

A glossary and suggestions for further reading are appended, although there is no index. T. H. H.

The Newer Knowledge of Nutrition

By Prof. E. V. McCollum, Dr. Elsa Orent-Keiles and Dr. Harry G. Day. Fifth edition, entirely rewritten. Pp. ix+701. (New York: The Macmillan Company, 1939.) 18*s*. net.

It is like meeting an old and much-loved friend after many years to have in one's hand a new edition of "McCollum". This is the fifth and it appears after an interval of no less than ten years, which is a whole epoch in the recent history of nutritional science. In its preparation Prof. McCollum has had the assistance of two collaborators, Elsa Orent-Keiles and Harry G. Day, and I rather feel the work has to a slight extent lost individuality as a result. But that is a small fault to find with a work that so ably and so adequately reviews the wide range of human and animal nutrition. Indeed, instead of a slight sense of disappointment that the book has not quite the 'personality' earlier editions had, one should feel very grateful that Prof. McCollum and his two colleagues have succeeded in producing a little more than six hundred very readable pages from their survey of so vast a literature. It need scarcely be said that the work is indispensable to all who wish to keep abreast with nutritional science and its application to human and animal welfare. But Prof. McCollum must realize that having produced what has for long been regarded as a standard work, we shall all be greatly disappointed if we are obliged to wait ten years for the next edition. J. C. DRUMMOND.

The Physiological Basis of the Art of Singing

By Haydn Hemery. Pp. xviii+139. (London: H. K. Lewis and Co., Ltd., 1939.) 10*s*. 6*d*. net.

Singing is without question an art, but there should be at least an element of science in the training of singers. The technique employed is very difficult to discover from conversation with teachers of singing. The difficulty is partly due to lack of common vocabulary, and too often also the same words are used by singers and scientists with quite different meanings.

The literature of voice training is comparatively small. The 'secrets' of the teachers have been for the most part passed down by word of mouth from one generation to the next. Mr. Hemery has attempted to supply the written deficiencies in a way in which teachers of singing can learn more of the scientific side of their work. The simple and clear anatomical diagrams are perhaps the most valuable part of the book.

For the scientific reader the book is scarcely satisfying, nearly every page leaving a number of queries in the mind. Moreover, the science is curiously mixed with unscientific statements, as, for example, in the numbered captions to one of the chapters, which runs thus: "Love is unification at an emotional level, for it is impossible to love and be wise."

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duction of flavour in bacon and ham (Food Investigation Special Report No. 49. "The Function of Nitrate, Nitrite, and Bacteria in the Curing of Bacon and Ham". H.M. Stationery Office. 9*d.* net). Curing of pork for bacon and ham was originally a process of dry salting. Now, the pickle used is liquid, and the process is supplemented by injecting the pickle into the tissues of the carcass. The traditional pickling materials—salt and saltpetre—are still used in Great Britain, but it has long been known that the 'cured colour' is due to the formation of nitrite by the action of bacteria upon the saltpetre. The nitrite formed reacts with the blood colouring matter present to form a special pigment, nitroso-hæmoglobin. It is shown that a satisfactory English bacon can be made by using only sodium chloride and sodium nitrite in the pickle, and that bacteria and nitrate are not essential for the development of the flavour. A very small content of free nitrite, as low as ten parts per million in the final product, is sufficient to produce a satisfactory flavour and colour. The report indicates the possibility of recasting the present practice so as to give the curer better control over the quality of this product.

The Stoic

The April number of the *Stoic* represents, not the "famed Athenian Porch", but Stowe School, which, starting at one of the great houses which flourished in the eighteenth century, has long since won its way to recognition on a par with older foundations. The school magazine is one of the best we have seen, including literary matter as well as the usual records of activities. Stowe is now responsible for two London clubs for boys. It produces its own films, which have dealt with several classes of animals and plant-life, while the Natural History Society, started last year, keeps a journal of work done which is well spoken of. The school evidently enjoys many things besides the normal curriculum. The illustrations make a good show and include a lively "Decorated Black-out Screen" designed by a young artist.

Earthquakes in the United States and in Italy

On Saturday and Sunday, May 18 and 19, severe earthquake shocks were experienced in the south-western United States and in Italy. In the United States eleven shocks were felt at places so far apart as 800 miles in Southern California and Arizona. The town of Imperial is reported in ruins, with five people killed and many injured. Owing to the disruption of communications, further details are not yet available. The place most affected in Italy appears to have been San Servo.

Other Recent Earthquakes

Reports from the seismological observatories at Kew (England) and De Bilt (Holland) confirm that there were two large earthquakes on May 4 and one on May 5. At Kew the first commenced recording at 7h. 35m. 55s. G.M.T. on May 4, and the epicentre was estimated to be distant 8,500 km. The second was received at Kew at 21h. 10m. 7s. G.M.T. on the same day, with an estimated epicentral distance of 4,770 km., and gave rise to ground amplitudes of 54 μ. The third commenced recording at 2h. 16m. 40s. G.M.T. on May 5 at Kew, and the estimated epicentral distance was 9,750 km. These readings have been confirmed by equivalent readings from De Bilt. Dr. G. van Dyk is of the opinion that the first on May 4 originated near the Aleutian Islands. which has recently been observed to be seismically active (Nature, May 4, p. 701 and earlier issues) and that the second on May 4 may have come from an easterly azimuth.

The Night Sky in June

The nights around the summer solstice on June 21 are shorter than 7½ hours in the latitude of London, reckoned from sunset to sunrise; excluding twilight (nautical) darkness lasts only about three hours. The moon is new on June 6 and full on June 19. Venus, which is still a brilliant evening star at the beginning of the month, draws rapidly towards the sun's place and is at inferior conjunction on June 26. Mercury is also an evening star in conjunction with Venus on June 12 and with Mars on June 17; on June 24 Mercury is at greatest elongation (25° east). Mars is getting less easy to see; it is close to Venus on June 7. Jupiter and Saturn are both morning stars, the former rising soon after 1h. 30m. U.T. on June 16, followed ¼ hr. later by Saturn. At dusk in mid-June, the red star Antares is about south. Arcturus has already southed, while Vega is some 3 hours before the meridian. The constellations, Boötes, Hercules and Ophiuchus contain some interesting double stars of which ε Boötis (2·8″), ξ Bootis (5·1″), α Herculis (4·8″) and 70 Ophiuchi (6·6″) are good examples. Between η and ζ Herculis may be glimpsed with the naked eye under favourable conditions the great star cluster, *M*13, the distance of which is of the order 35,000 light years. The outer part of the cluster can be resolved into stars with a 2½- or 3-inch refractor. The Scorpiid meteors are at their greatest frequency about June 4, their radiant point being north, following Antares.

Announcements

The Editors of Nature have decided that, for the time being, the receipt of the manuscript of contributions cannot be acknowledged. Furthermore, it is found essential to reduce the number of proofs sent to the author of contributions submitted to one. This proof must be accepted as an acknowledgement of receipt of the copy.

Among his personal assistants, the Prime Minister has appointed Prof. F. A. Lindemann, F.R.S., professor of experimental philosophy in the University of Oxford, for advice concerning statistics and research.

Dr. H. Shaw, keeper in the Department of Physics and Geophysics at the Science Museum, has been appointed acting director of the Museum during the absence of Brigadier E. E. B. Mackintosh.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 825. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Transformation of Mesotrons into Electrons

EVIDENCE for the transformation of mesotrons into electrons was recently reported in these columns[1]. This was obtained by the use of the cloud chamber, and consisted in the observation of a fast electron track emanating from the end of the track of a mesotron. What appears to be another instance of this phenomenon was recently observed in this laboratory, though on account of the tracks being rather old and accompanied by other old tracks the photograph is not as good as the earlier one. Apart from a further indication of the frequency of occurrence of the phenomenon, it does not give any new information.

The probability of catching a mesotron coming to the end of its range in a cloud chamber, with random expansions, is greatly enhanced if the chamber is large or contains gas at a high pressure. In the work previously reported a large chamber (60 cm. diameter, 50 cm. deep) operating at atmospheric pressure was used. (This chamber has since been operated at four atmospheres.) The present tracks were observed in a cloud chamber of moderate dimensions (20 cm. diameter, 16 cm. deep) containing argon at 80 atmospheres. A distance of 15 cm. in this chamber is equivalent in stopping-power to about 2 cm. of water, or 16 metres of standard air. Actually the total length of track (old and new) of cosmic-ray particles observed up to date in the high-pressure chamber, and in the large chamber, is equivalent to about 5×10^6 cm. of standard air. The observation in these experiments of two mesotron-ends thus corresponds to 4×10^{-7} mesotron-ends per cm. of cosmic-ray track in air. The number expected as the result of the slowing down of fast mesotrons (cf. ref. 3, p. 210) is equal to the product of the number of fast mesotrons (energy $T, \sim 5 \times 10^8$ volts) per unit energy interval per cosmic-ray particle, the rate of loss of energy in air by fast mesotrons (energy T), and the decay factor for mesotrons of energy T under the conditions concerned, $\sim 3 \times 10^{-4}$ per Mev. $\times 3 \times 10^{-3}$ Mev. per cm. $\times 0{\cdot}6 \sim 5 \times 10^{-7}$ per cm. The rough agreement with the observed frequency, and a similar agreement regarding the number of slow mesotrons observed in earlier work[2,3] indicate that there is not a very high probability for the removal of a mesotron from the cosmic-ray beam by some hitherto unknown process, unless there is a creation of slow mesotrons which happens to compensate roughly for the removal of fast ones.

The photograph referred to above is reproduced in Fig. 1. AB and BC represent the tracks concerned. The appearance of these is consistent with a mesotron AB coming to the end of its range at B and transforming into an electron BC. The tracks in the neighbourhood of B show that the illumination was fairly uniform in that region. That AB is the track of a slow particle ($v \ll c$) is shown by the relative high density of ionization along it as compared with BC. It might be pointed out that the length of dense track rules out an electron as the responsible particle, since at these pressures an electron is fast up to the last few millimetres of its range. (It will be noticed that a track which enters the chamber near A appears also to terminate in the gas with a faint track leaving the neighbourhood of its end. While this resembles a mesotron disintegration more than anything seen in all the other photographs (about 1,400) the conditions near the end of the track, such as weak illumination, are too poor to warrant any inferences. It may possibly be the track of opposite sign to AB, separated from it by the electric field.)

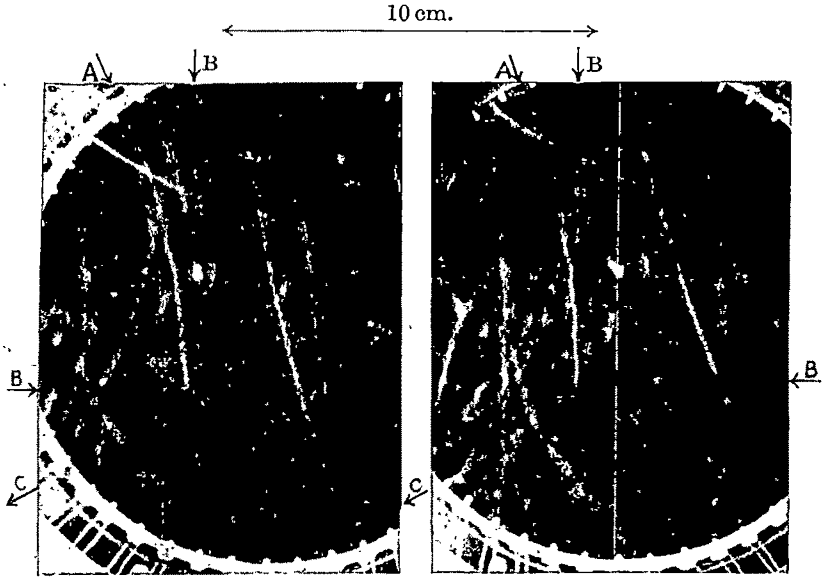

Fig. 1.

FOR STEREOSCOPIC VISION, THE LEFT-HAND PHOTOGRAPH SHOULD BE VIEWED BY THE RIGHT EYE, AND *vice versa*.

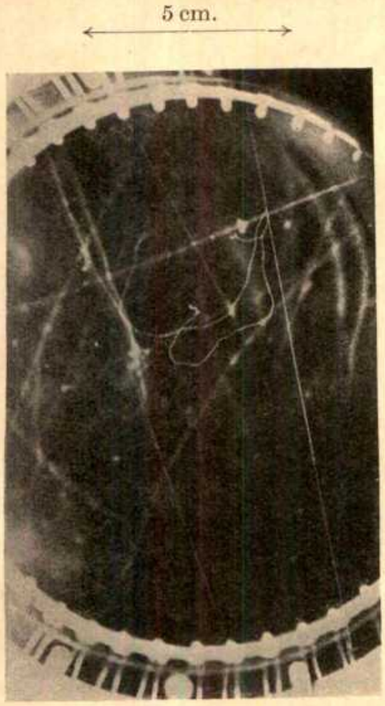

Fig. 2.

It is of interest to consider the probability of the occurrence of the tracks *AB*, *BC* by the chance coincidence of the beginning of a fast high-energy track with the end of a heavy track. In all the other photographs taken with the high-pressure chamber, about 1,200, there is only one clear case of a heavy track—probably a proton—terminating in the chamber, and about half a dozen doubtful cases of tracks, not necessarily heavy, ending or beginning in the chamber. Even assuming that one fast track starts in the chamber in every photograph, which is a gross over-estimate, the above probability is then of the order of 6 × (thickness of track)^3 ÷ (volume of illuminated part of chamber) $\sim 6 \times (0{\cdot}1 \text{ cm.})^3 \div (13^2 \text{ cm.}^2 \times 5 \text{ cm.}) \sim 10^{-5}$. The corresponding upper limit to the probability of the chance imitation of the example observed in the large chamber reported earlier[1], is $1 \times (0{\cdot}04 \text{ cm.})^3 \div (40^2 \text{ cm.}^2 \times 12 \text{ cm.}) \sim 10^{-8}$. The probability of both examples being an accidental coincidence is accordingly much less than 10^{-13}.

AB is obviously distorted by scattering, while both *AB* and *BC* are probably distorted by air-motion and by the electric field (before condensation). Their radius of curvature ($\sim$ 25 cm. for each) has therefore no significance of value. It might, however, be mentioned that a mesotron of the same range, with a mass one tenth that of a proton, would have an overall radius of curvature of about 50 cm. due to the magnetic field (2,700 gauss) and a natural curvature, due to scattering, equal on the average to about 30 cm. (For a proton these would be greater by factors of about 5 and 3 respectively.) If the electron, *BC*, had half the mass energy of the mesotron ($\sim$ 40 Mev.), its radius of curvature due to the field would be about 50 cm., and about 350 cm. due to scattering.

We reproduce in Fig. 2 a photograph, taken under the same conditions as that reproduced in Fig. 1, showing two sharp tracks, which is about the average number of sharp tracks per photograph. These are little disturbed by air motion. One is seen to produce two fast secondary electrons, the angles of projection of which indicate an initial energy of about 3 Mev., corresponding to a range of about 15 metres of air at N.T.P.

E. J. Williams.
G. R. Evans.

University College of Wales,
Aberystwyth.
April 7.

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[1] Williams and Roberts, NATURE, **145**, 102 (1940).

[2] Williams and Pickup, NATURE, **141**, 684 (1938).

[3] Williams, *Proc. Roy. Soc.*, A, **172**, 194 (1939).

Classical Theory of Point Dipoles

It is well known that a limit to the validity of quantum mechanics is set by its neglect of the effects of radiation damping, and an indication as to where this limit occurs is given in electron theory by the classical equation of Lorentz, which takes radiation damping into account. Now the interaction of the meson field with a neutron or proton contains an explicit dipole term, and this leads to scattering cross-sections for mesons which increase quadratically with the energy. A classical treatment of radiation damping for a dipole would thus give us the limits of the quantum theory due to neglect of this factor. A non-relativistic attempt has already been made by Heisenberg[1] for a dipole of finite extension, but his results even in the limit of a point dipole do not agree with ours. We believe that this is because the usual method of calculation which he follows is inconsistent with the theory of relativity, for whereas the retardation of the field is taken into account, different parts of the dipole are assumed to move instantaneously in phase.

The method used by Dirac[2] for a point electron, and by me[3] in the classical theory of mesons, has been extended for finding the exact classical relativistic equations for the motion of a point-dipole described by a six-vector $S_{\mu\nu}$.

It will be shown in a paper with Corben that the flow of energy and momentum out of a world-tube of radius ε surrounding the world-line of the dipole contains certain terms which tend to infinity as $\varepsilon \to 0$, but these are all perfect differentials, and hence may be subtracted as in the previous papers. The flow of ***total*** angular momentum out of the tube (including the *orbital angular momentum*)[4] contains similar singular terms, but these are also perfect differentials and may be subtracted as before (the calculation of the singular terms is entirely due to Dr. H. C. Corben). Thus completely definite equations free from singularities can be found for the rotation and translation of a point dipole.

Using these results, I have been able to show the following:

The charge g_1 and dipole moment g_2 are independent constants, and the mass M and angular momentum of the spin I also appear as *independent* and arbitrary constants in the equations. Further, it is also true in the special case $S_{\mu\nu} v^\nu = 0$ (v^ν is the 4-velocity of the dipole), where the dipole is always a pure magnetic dipole in the system in which it has no translational motion. This is in definite disagreement with a paper by Kramers[5] in which a relation between the four constants was deduced.

The case where $S_{\mu\nu}v^{\nu}$ is variable can be treated quite consistently, and *if* radiation damping be neglected, is mathematically simpler than the case $S_{\mu\nu}v^{\nu} = 0$. But when radiation damping is taken into account, the former is vastly more complicated than the latter. It is satisfactory to find that it is the simpler case which is the only one to occur in Nature. The complete rotational and translational equations when $S_{\mu\nu}v^{\nu} = 0$ have already been given elsewhere[6] for the special case $g_1 = 0$, $g_2 \neq 0$.

In view of what has been said above, if we wish to consider only the rotational motion of the dipole, we may let the mass M of the dipole tend to infinity, in which case v_{μ} and its derivatives vanish. The rotational equations then take on a particularly simple form, namely

$$I \dot{S}_{kl} = g_2(S_{km} F^m{}_l - S_{lm} F^m{}_k) - \frac{2}{3} g_2{}^2 (S_{km} \dddot{S}^m{}_l - S_{lm} \dddot{S}^m{}_k) \quad . \quad (1)$$

Here $F_{\mu\nu}$ is the ingoing electromagnetic field. The last term gives the effect of radiation damping.

With these equations, the cross-section for the scattering of light of frequency $\omega/2\pi$ by the dipole is[6]

$$6\pi \frac{\omega^2 \sin^2 \theta}{\omega^4 + 9I^2/4g_2{}^4}, \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where θ is the angle between the magnetic force of the light wave and the axis of the magnetic dipole. For small ω this becomes

$$\frac{8\pi}{3} \frac{g_2{}^4}{I^2} \omega^2 \sin^2 \theta, \quad . \quad . \quad . \quad . \quad . \quad (3)$$

which is the cross-section previously calculated on the quantum theory. It *increases* as ω^2. For large ω, however, the exact cross-section (1) becomes

$$6\pi \frac{\sin^2 \theta}{\omega^2},$$

and thus *decreases* as ω^{-2}.

Although (2) is strictly valid only for the scattering of light, it may be used to give an estimate of the scattering of meson waves by neutrons, for, as has been shown in a previous paper[3], the existence of the finite rest mass μ of the meson only *decreases* the above cross-section for energies $\hbar\omega \sim \mu$, while the cross-section is not appreciably altered for $\hbar\omega \gg \mu$.

The equation (1) and the cross-section (2) show that radiation damping becomes important when

$$\hbar\omega \gtrsim \hbar \sqrt{\frac{3I}{2g_2{}^2}}.$$

Putting $I = \hbar/2$ for a neutron, and the empirical value $g_2 = g_1\hbar/\mu$ (μ = meson mass) for the meson field, this gives

$$\hbar\omega \gtrsim \mu \sqrt{\frac{3\hbar}{2g_1{}^2}} \sim 2\mu.$$

(The velocity of light has been put equal to unity.) Thus we should expect the quantum theory of the meson neutron interaction to fail for energies higher than 2μ, *but this limit has really nothing to do with the mass of the meson and merely depends on the empirical magnitude of the constants g_2 and I.*

It is interesting to note that, whereas for the scattering of neutral mesons by neutrons quantum effects do not set in until $\hbar\omega \gtrsim M$ (where M is the neutron mass), the quantum theory already goes wrong for energies $\hbar\omega \gtrsim 2\mu$ due to neglect of radiation damping. Thus, contrary to what happens in electron theory, there is a region of energy $2\mu < \hbar\omega < M$ where the classical formula (2) will be correct, but the quantum formula (3) quite wrong.

To apply the same formula to the spin of the *meson* and its interaction with *electromagnetic fields*, we put $I = \hbar$, $g_2 = e\hbar/2\mu$, and find that the quantum theory of this interaction should fail when

$$\hbar\omega \gtrsim \mu \sqrt{\frac{6\hbar}{e^2}} \sim 28\,\mu,$$

a limit which is much higher than the limit given above at which the theory of nuclear interaction fails.

An electron has no explicit g_2 spin interaction with the Maxwell field, but *if* the above theory is applicable to its spin, then putting $I = \hbar/2$, $g_2 = e\hbar/2m$, we should expect the quantum theory of the electron to fail for energies

$$\hbar\omega \gtrsim m \sqrt{\frac{3\hbar}{e^2}} \sim \sqrt{(3 \times 137)}\, m,$$

that is, at energies much lower than 137 m, which has been hitherto supposed.

Thus our theory shows that a proper consideration of radiation damping automatically cuts down the scattering due to the spin term, and hence there is no necessity whatever for the *ad hoc* introduction of higher spin states as has been done by Heitler[7] in a recent note. In a previous paper[3] it was shown that the finite mass of the meson does not lead to Heisenberg explosions, and our present calculations show that the g_2 spin interaction does not give rise to these either.

The general theory will be published elsewhere with H. C. Corben when circumstances permit. Difficulties of communication have prevented a joint publication in the present instance.

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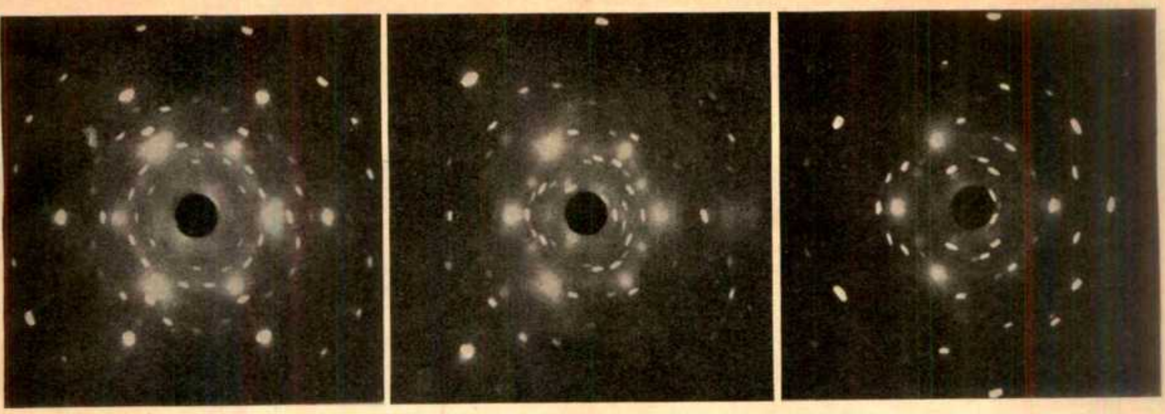
Anomalous X-Ray Reflections on Laue Photographs

Sir C. V. Raman and P. Nilakantan[1] have described a type of specular X-ray reflection to be found on Laue photographs of diamond taken with copper radiation normal to a (111) plane.

We wish to point out that similar effects have previously been observed by several workers[2]. In some of these cases the anomalies are due to mechanical strain or to age-hardening, but these explanations do not appear to account for all the observed phenomena, and a more general theory has been offered by G. D. Preston[3] in terms of the thermal vibrations of groups of atoms. His photographs of aluminium, sodium chloride and magnesium oxide show, in addition to the usual Laue diagram, a pattern of more diffuse spots which are greatly enhanced at high temperatures and remain even when the radiation is strictly monochromatized and the Laue pattern has disappeared.



a X-RAYS ALONG [0001] AXIS. *b* X-RAYS 10° FROM [0001] AXIS. *c* X-RAYS 15° FROM [0001] AXIS.

BENZIL; UNFILTERED COPPER RADIATION; 70 MIN. EXPOSURE AT 3·5 CM.

Many Laue photographs obtained in this laboratory over a period of years, using diamond, sodium, rock-salt and other compounds, show the effect; perhaps some of the most beautiful are those of benzil, here reproduced. It is significant that these anomalous patterns are much less sensitive to crystal mis-setting than are the ordinary Laue diagrams. In our opinion, further experimental evidence is desirable before any theory can be accepted as essentially correct.

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Optics of the Artificial Nylon Fibre

THE fibrils of which the artificial 'Nylon' fibre is composed exhibit a remarkably high double refraction. Although their diameter is only about 19 μ, they show interference colours of the third order. For the calculation of the double refraction their slightly elliptical cross-section must be taken into consideration. The large and the small diameter can easily be measured under the microscope with slightly twisted fibrils. The double refraction of the fibrils examined amounts to 0·060, the lower index n_a being 1·520 and the higher index n_γ about 1·580. It is surprising how closely these figures agree with those of silk fibroin[1] and natural cellulose fibres[2] (see table). When the fibrils are stretched they prove to be strikingly photo-elastic; the retardation may increase by 30 per cent before the fibril breaks.

	'Nylon'	Silk	Ramie
$(n_\gamma)D$	1·580	1·584	1·599
$(n_a)D$	1·520	1·529	1·532
Double refraction	0·060	0·057	0·067

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Oxide Films on Alloy Steels

IN a recent communication[1], T. Tokumitu concludes that the naturally occurring oxide film on stainless steels is α-$(Fe,Cr)_2O_3$, and he bases this conclusion upon the fact that heating the natural oxide layer to 600° C. for one hour suffices to change the electron diffraction pattern from one of blurred rings which cannot be analysed, to a well-defined pattern of α-$(Fe,Cr)_2O_3$. The crystalline structure adopted by the film on heating, however, may very well be different from that of the natural oxide, and even the chemical composition may be changed, since, unless the heating is carried out in an exceedingly good vacuum or its equivalent, the film may gain oxygen, and also, as Pfeil[2] has shown in the case of thick scales, diffusion of metal atoms towards the oxide surface occurs at high temperatures.

Furthermore, the work of Jackson and Quarrell[3] shows that when the electron diffraction examination of oxide films is carried out at room temperature, the results are apt to be misleading. Thus, with 'Armco' iron and plain carbon steel specimens, oxide films formed and examined at temperatures of 350°, 600° and 950° C. gave patterns corresponding to Fe_3O_4, FeO and Fe_3O_4 respectively, but on examination at room temperature all three surfaces gave the pattern which is generally attributed to Fe_3O_4. Indeed, it was possible to correlate the oxide structure with the temperature of formation by using the new high-temperature technique and to show, for example, that, on cooling, the Fe_3O_4 formed above the A_3 critical point of the metal specimen passed through two transformations corresponding to $Fe_3O_4 \rightarrow FeO \rightarrow Fe_3O_4$. In view of the possibility of such changes occurring in other cases, it is not advisable to attach too great an importance to the electron diffraction patterns of oxide films recorded at room temperature.

Recent application of the high-temperature method of electron diffraction to thin oxide films formed on a heat-resisting steel of the composition 0·47 per cent carbon, 0·72 per cent manganese, 1·7 per cent silicon, 12·9 per cent nickel, 13·1 per cent chromium and 3·1 per cent molybdenum, has shown that at temperatures up to 950° C. the oxide has a spinel structure. The spinel structure is possessed by a large number of oxides of the general type $XO.Y_2O_3$, and minerals are obtained in which the X positions on the lattice are shared among two or more metals, and there is also evidence that the X and Y atoms are interchangeable. Only small differences in lattice parameters are observed among the oxide spinels, and it seems, therefore, that the spinel structure is both exceedingly flexible and inherently stable. The relative instability of the $FeO.Fe_2O_3$ spinel on 'Armco' iron must be regarded as exceptional and attributable to the fact that both X and Y lattice positions are occupied by atoms of the same metal, thus making possible the $Fe_3O_4 \rightarrow FeO$ transformation. With the more general type of spinel oxide, containing at least two different metals, a corresponding change is not possible, and therefore the structure should be stable over a much wider range of temperatures. The oxide formed on nickel-chromium alloys has been shown to have a spinel structure and probably a composition corresponding to $NiO.Cr_2O_3$. There can be no doubt that in this case the spinel affords excellent protection against further oxidation at high temperatures.

In view of the foregoing, it seems reasonable to suggest that the oxidation resistance of heat-resisting steels is largely due to the formation of a stable spinel. Provided such elements as nickel, chromium and aluminium are present in sufficient quantities, the spinel structure should be stabilized and should, moreover, be able to accommodate almost any metal which may be added to the steel for the purpose of improving its mechanical properties at high temperatures. The absence of lattice changes on heating and cooling will prevent easy access of oxygen to the underlying metal surface and so greatly increase the oxidation resistance.

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Benzanthrones

In a previous publication[1] it was stated that, contrary to Schaarschmidt and Georgeacopol[2], the ring closure of *o*-α-naphthylbenzoic acid gave a mixture of *meso*benzanthrone and 3 : 4-benzfluorenone.

Since then, Grieve and Hey[3] have reported the same results as Schaarschmidt and Georgeacopol[2], without the isolation of 3 : 4-benzfluorenone. I had to repeat my experiments later, using different condensing agents (concentrated sulphuric acid, phosphorus pentachloride followed by aluminium chloride, and phosphorus pentoxide) at different temperatures. In none of these attempts, however, was *meso*benzanthrone obtained free from 3 : 4-benzfluorenone.

The condensation of diazotized methyl anthranilate with α- and β-methylnaphthalene[4] at 25° gave, in a poor yield, a mixture of acids and *o*-2′-methyl-1′-naphthylbenzoic acid respectively. The yield was improved by altering the condition of the reaction.

o-4′-Methyl-1′-naphthylbenzoic acid was easily prepared by condensing 4-iodo-1-methylnaphthalene with *o*-iodobenzoic ester (cf. Baddar and Warren[1]). Cyclization of this acid gave also a mixture of 1′-methyl*meso*benzanthrone and 2-methyl-3 : 4-benzfluorenone.

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Action of Ions on Acetylcholinesterase

REFERRING to the publication of D. Nachmansohn[1], we wish to direct attention to the fact that we have previously described[2] the effect of different divalent ions on the activity of acetylcholinesterase. We think that for some reason this paper did not reach Dr. Nachmansohn.

We have shown that manganese, magnesium and calcium ions are especially active ; strontium and barium ions are active to a less degree. Inhibition experiments with sodium fluoride, sodium oxalate and others and the optimal concentration of $Ca^{++}(M/500)$ for reactivation after dialysis, revealed the outstanding position of calcium as an activator of acetylcholinesterase in horse serum. We agree with the fact that the electric organ of Torpedo is a far better enzyme material ; but horse serum allowed us to demonstrate essentially the same facts as those observed by Nachmansohn, concerning the effect of divalent ions on the activity of acetylcholinesterase.

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[2] Massart, L., and Dufait, R., *Enzymologia*, **6**, 282 (1939).

(BY CABLE.)

D. NACHMANSOHN claims[1] that his findings concerning the activation of cholinesterase by electrolytes are "in contrast" to our results reported some time ago[2]. This statement is misleading, as his results were obtained under different conditions and therefore cannot be compared with ours.

The enzyme preparation from the electric organ of Torpedo used in Nachmansohn's experiments appears to have properties unlike those of our preparation obtained from horse serum. While both preparations will hydrolyse the same substrate, there are indications that we are dealing with different enzyme complexes. For example, the activity of the serum preparation is only slightly diminished by dialysis while Nachmansohn's preparation is almost completely inactivated ; further, the serum enzyme, in contrast to Nachmansohn's preparation, may be treated with ammonium sulphate as well as evaporated to dryness without any loss of activity.

It is difficult to understand what Nachmansohn means when he says: ". . . the enzyme preparations . . . obtained from horse serum . . . appear to have been less active and of a lower degree of purity than those previously described" (by Nachmansohn), as 1 mgm. of both enzyme preparations hydrolyses 100 mgm. of acetylcholine per hour.

As pointed out in our communication, the effect of added electrolytes depends greatly on the concentration of the substrate, being much more pronounced at a lower concentration of acetylcholine (0·025 per cent). We are unable to find any evidence that Nachmansohn has carried out experiments under such conditions.

Without knowledge of our work, L. Massart and R. Dufait[3] in July 1939 reported that they had found an augmentation of cholinesterase activity by 0·002 mol. calcium which could be abolished by addition of oxalate. Though they found magnesium and manganese to act in a similar way they expressed the opinion that "calcium est l'activateur physiologique de la choline esterase du serum". As these authors used dialysed horse serum without any further purification in their experiments, it would appear that the degree of purity of the enzyme does not affect the results. We have recently repeated our experiments with a preparation of much higher purity (1 mgm. hydrolysing 200 mgm. of acetylcholine per hour) and have found it to act in exactly the same manner as previously reported by us.

It is suggested that the activation which Nachmansohn found with concentrations of potassium and sodium as high as 0·1 mol. is due to traces of bivalent ions. According to Nachmansohn's own experiments, these ions, if only present as impurities of the order of 0·01 per cent, would at least partly reactivate his enzyme preparation.

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Connexion between Carbohydrate and Potassium Metabolism in the Yeast Cell

WILLSTÄTTER and co-workers[1] have shown that if glucose is added to a suspension of yeast cells, it disappears from solution and is built up into a polysaccharide (glycogen), inside the yeast cells. Only after this (in about ten minutes time) does the fermentation begin, as tested by the production of carbon dioxide.

Since it was found[2] that there are intimate connexions between carbohydrate and potassium metabolism in animals, and since it is well known that the carbohydrate metabolism of the yeast cells is in many ways similar to that of muscle, we tried whether potassium plays any part in the fermentation of sugar by the yeast cell.

The following experiments were made with a 20 per cent yeast suspension, and the figures given in the accompanying table are the amounts of sugar and potassium in 5 c.c. of centrifuged fluid. As can be seen from the table (and as has been repeatedly found in many more experiments), the glucose disappears to the extent of about 90 per cent in ten minutes and almost completely in twenty minutes. The fermentation, as tested by the production of carbon dioxide, begins in six minutes, and the amount of carbon dioxide produced is given between the tenth and fifteenth minutes. These figures serve to give some indication of the intensity of the fermentation.

CHANGES OF POTASSIUM AND GLUCOSE IN A 20 PER CENT SUSPENSION OF YEAST

(Glucose added at 0 min. All values are mgm. in 5 c.c. centrifuged fluid.

Time (minutes)	With glucose		Same with $M/2000$ iodoacetic acid		Same with $M/300$ NaF	
	K	Glucose	K	Glucose	K	Glucose
0	0·672	33·0	0·686	31·5	0·677	33·1
10	0·196	3·75	0·852	26·2	0·625	29·3
20	0·288	1·5	0·953	18·1	0·562	20·0
40	0·352	—	1·087	10·8	0·495	11·3
60	0·571	—	1·317	8·7	0·855	1·7
120	0·828	—	1·773	6·2	1·505	—
CO_2 production starts	6 min.		8 min.		8 min.	
Quantity between 10–15 min.	16·2 c.c.		1·1 c.c.		1·35 c.c.	

Of special interest is the behaviour of the potassium, which is found to decrease rapidly in the fluid during the first ten minutes while sugar is being taken into the yeast cells. When the fermentation of sugar in the cells starts, the potassium is liberated again and reaches even higher levels than before in the outer fluid.

This experiment can be repeated several times with the same yeast suspension if glucose is repeatedly added when the preceding dose of sugar has been totally fermented. In every case potassium decreases in the fluid during the up-take of glucose and increases when the production of carbon dioxide begins.

Control experiments showed that when no glucose is added to the fluid, the potassium remains constant. It is unaltered by changes in hydrogen ion concentration, and since the concentration of sodium in the fluid remains constant during glucose up-take and fermentation, the behaviour of potassium appears to be specific and not due to general permeability changes.

The action of iodoacetic acid on these processes was studied in different concentrations. $M/2000$, as the table shows, retards markedly the up-take of glucose into the cells (that is, the polysaccharide formation) so that this is incomplete even after a hundred and twenty minutes.

The small quantities of glucose which are taken up are, however, fermented, the fermentation commencing after eight minutes, but only 1·1 c.c. of carbon dioxide was produced between the tenth and fifteenth minutes.

The behaviour of potassium after iodoacetic acid is most striking. No disappearance of potassium from the fluid is seen. There is only a slight increase in potassium when the fermentation of glucose in the cells begins. Thus iodoacetic acid has inhibited both the up-take of glucose by the yeast cells and simultaneously the up-take of potassium. The inhibition of fermentation in the cells appears to be only secondary.

Phlorrhizin has no effect in concentrations as high as $M/750$, and sodium cyanide has an action only at $M/300$, when it distinctly retards all processes, though to a lesser extent than iodoacetic acid. Sodium fluoride at $M/300$ behaved similarly.

It may be noted that baker's yeast contains about 4 mgm. of potassium per gm., of which about 15 per cent can be washed out, while the rest is retained. All experiments were made with yeast which, after washing for several hours, was in equilibrium with suspension fluid as regards potassium.

The experiments show that potassium is taken up by the yeast cells simultaneously with the glycogen formation, and that with the breakdown of glycogen it is again liberated. It is a probable assumption that this movement of potassium is connected with the production of phosphoric esters of the sugars as intermediate reactions in the polymerization and breakdown of glycogen. This would agree with our findings on the role of potassium in carbohydrate metabolism in animals[2].

A detailed report will be published later.

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[2] Verzár, F., and Somogyi, J. C., NATURE, **144**, 1014 (1939); **145**, 781 (1940).

Seed Disinfection

CERTAIN proprietary seed disinfectants and protectives which contain organo-mercury compounds as their fungicidal basis are now used extensively for disinfecting cereal seed prior to sowing. When correctly used they give an excellent control of many seed-borne diseases, but in some circumstances, injury to the grain may result, and it is the purpose of this note to indicate those conditions which may lead to such injury. These materials are also used for treating such seeds as peas, sugar-beet, etc., but the observations given here are confined to cereals.

In these seed disinfectants, the fungicidal salt is often a member of the series R. Hg. X, where R is a hydrocarbon and X an acidic radicle. In some cases mixtures of such salts are used. In this series there is a close relationship between composition and fungicidal power, the toxicity decreasing with the increase of the molecule of R. In certain circumstances such salts may produce a characteristic phytocidal effect when they are applied to, and held by, the grain in over-doses. The seed may be killed outright or it may commence to germinate and the coleoptile to appear, but further development is abnormal, characterized by thickening of the tissues of the coleoptile and stunting of the roots. Porter[1] reports that such seedlings have thickened leaf primordia with irregular crenations and lobes. Cell division is inhibited, the existing cells becoming enlarged and multinucleate, either with small nuclei or with large 'giant nuclei' which are polyploid.

We have observed that the primary roots are usually short and thickened, their development being arrested soon after they emerge. Root hairs are frequently absent, and in these cases the seminal roots are usually discoloured brown.

Typically abnormal seedlings seldom develop further, and neither they nor the killed seeds decay rapidly in the soil. We have noted this characteristic injury both in laboratory tests and in the field and we have investigated those conditions under which it may be induced. The effect of these dust disinfectants upon seed which has been treated and then stored under varying conditions has also been examined.

We have found that provided the grain shows relatively high initial germination, is of sound physical condition and is superficially dry when dusted with these materials, then no immediate injury to the grain is likely to result. If such seed has to be stored, then provided it is kept under dry, cool conditions, with adequate ventilation, it is unlikely that any significant loss of germination capacity will ensue during several months. With such well-conditioned seed it is not possible to give any markedly excessive doses, as the dust cannot be retained by superficially dry seed beyond a certain limit.

A factor of some importance appears to be the relative superficial moisture of the seed. If such seed is dusted, even at the recommended rate, that part of the bulk of seed upon which the dressing falls will retain excessive quantities. The subsequent mixing will result in a distribution throughout the bulk of a proportion of heavily over-dusted seeds. These may be killed or may produce abnormal seedlings, thus resulting in an uneven stand. Intentional or accidental application of dust to damp seed, at rates higher than those recommended, will tend to produce more markedly adverse results.

Injury may also result if dry and well-conditioned grain is treated at normal rates but is afterwards stored under damp conditions with poor ventilation.

The moisture content of the seed (as opposed to superficial moisture) is another factor we have investigated, but we have obtained little or no evidence that treated seed of a moisture content slightly above normal suffers any immediate and serious phytocidal effects. Preliminary observations suggest that seed of high moisture content which has been dusted at normal rates and then stored suffers loss of viability to no greater degree than does undusted seed of similar moisture content.

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[1] Porter, R. H., "Relation of Seed Disinfectants to Seed Analysis". *Proceedings of the Association of Official Seed Analysts of North America (1936).*

Origin of the Frow Remedy for Acarine Disease of Honey Bees

IN 1927, Mr. R. W. Frow, of Wickenby, Lincolnshire, introduced the use of the remedy (since known by his name) as a cure for acarine disease. Mr. Frow informs one of us (A. D. B.) that he has no record of the origin of the formula, but believes that he read of it in a newspaper as a means of combating free-living acari.

We are anxious to trace the origin of the formula, which is:

Nitrobenzene . .	2 parts (by measure)
Safrol oil . . .	1 part
Petrol (preferably 'Summer Shell') .	2 parts

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A Colour Reaction of Diethylstilbœstrol (4.4′ dihydroxy-α, β-diethylstilbene)

Dodds *et al.*[1] discovered a series of non-steroid œstrogenic compounds, 4.4′-dihydroxy-α, β-diethylstilbene, or diethylstilbœstrol, being the most potent representative of this series. In addition to its œstrogenic effect, this compound has other effects in common with the steroid type of œstrogens; for example, it opens the vagina of infantile rats and mice, it stimulates the evolution of the uterus and prevents the appearance of 'castrate'-cells in the ventral pituitary.

Besides these effects, others have been found, for which the natural and artificial œstrogens are no longer interchangeable.

Mühlbock[2] reported on the inhibition of comb growth by the simultaneous administration of male substances with œstrogens. The natural œstrogens act in this way when administered subcutaneously or by inunction; diethylstilbœstrol, however, is active only when administered subcutaneously.

Loeser[3] claims that diethylstilbœstrol, in contradistinction to natural œstrogens, has no influence on the thyroid after intrauterine application. Levie[4] and Gaarenstroom and Levie[5] found that stilbœstrol hastens the involution of epiphyseal cartilage more than œstrone. Duyvené de Wit[6] observed no lengthening of the ovipositor of *Rhodeus amarus* by stilbœstrol.

These effects may be suitable for discriminating biologically between a solution of natural from one of artificial œstrogens, but are unlikely to provide reliable quantitative information on mixtures of the two substances. The exact estimation of small quantities of diethylstilbœstrol in solutions of œstrone or œstradiol has now been achieved, however, by means of a colour reaction.

Addition of a few drops of a 50 per cent solution of antimony pentachloride to a solution of a few micrograms of stilbœstrol in chloroform produces a fuchsin-red colour, while in more concentrated solutions a bordeaux-red precipitate is obtained. By warming the mixture the reaction becomes more sensitive; 1 γ of stilbœstrol per c.c. of chloroform can still be detected, which amounts to a dilution of 10^{-6}. The colour attains its maximum intensity after 15 min. and remains constant for another 10–15 min.

For the detection of stilbœstrol in an oily solution of natural œstrogens the fatty and unsaponifiable substances must be removed prior to the colorimetric assay, because these substances would produce a dark brown discoloration. At a thousand times higher concentration, namely, 1 mgm./c.c., natural œstrogenic substances (steroids) produce a yellow-brown coloration with antimony pentachloride. The removal of these steroids from the solution will be described elsewhere.

It is important to use alcohol-free chloroform as a solvent, since in the presence of alcohol the red colour rapidly changes to blue-violet. For the colorimetric estimation a standard diethylstilbœstrol solution of similar strength to the unknown is used. The colorimetric assay has been successfully applied to the estimation of diethylstilbœstrol in the urine and the liver of dogs after subcutaneous injection of the hormone. The amounts found colorimetrically were the same as those ascertained by biological assay. The urine extracts were purified before carrying out the assay.

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Points from Foregoing Letters

E. J. Williams and G. R. Evans submit photographs providing further evidence for the transformation of mesotrons into electrons, the first evidence for which was obtained at the same laboratory a short time ago. The experiments were carried out in a high-pressure cloud chamber containing argon at a pressure of 80 atmospheres.

H. J. Bhabha has extended his classical theory of mesons to include a treatment of the dipole moment, and shows that all the infinities can be removed. The cross-section for the scattering of neutral mesons by neutrons calculated from this theory agrees with the quantal result for small energies, but is much less than the latter for high energies, decreasing as the square of the energy. The result shows that the theory does not lead to Heisenberg explosions when proper account is taken of the damping forces.

In a note on the nature of oxide films on alloy steels, A. G. Quarrell criticizes the reasoning on which T. Tokumitu based his conclusion that the natural oxide film formed on stainless steel is α-$(Fe,Cr)_2O_3$. Recent application of the high temperature electron diffraction technique leads to the suggestion that the oxidation resistance of heat-resisting steels may be due to the formation of a stable spinel oxide which undergoes no lattice changes on heating and cooling.

F. G. Baddar finds that *o*-α-naphthylbenzoic acid and *o*-4′-methyl-1′-naphthylbenzoic acid give on ring closure a mixture of a benzanthrone and a benzfluorenone. Interaction between diazotized methyl anthranilate and β-methylnaphthalene gives *o*-2′-methyl-1′-naphthylbenzoic acid.

R. Pulver and F. Verzár, in continuation of their experiments on the role of potassium in carbohydrate metabolism, show that in yeast cells intake of potassium is simultaneous with glycogen formation, and that with the breakdown of glycogen potassium is again liberated. This agrees with their previous findings on the role of potassium in carbohydrate metabolism in animals.

RESEARCH ITEMS

Age and Sex in New Guinea Skulls

In a study of skulls from New Guinea, now in the Field Museum of Natural History, Chicago, by W. D. Hambly (Anthrop. Series, **25**, 3, 1940) attention is directed to certain conclusions in regard to age and sex emerging from craniometric investigation of the material of 222 skulls. 28 are excluded as juvenile. Of the remainder, 70 are female and 124 male, distributed into southern and northern groups. In the southern group a high mortality in both sexes occurs in the age-period 20–30 years, accounting for about 46·4 per cent of the population. There is a noticeable decline in mortality at the age of 30–40 years, the rate falling to 12·5 per cent, but with a rise for 40–45 years, though for survivors there is a fair expectancy of reaching 50 years. About 16·7 per cent females and 15·8 per cent males pass the 50-year mark. In the northern group the rate in the years 20–30 is high, that of females reaching 65·4 per cent in the years 20–25. For males and females together from 20 to 30 the rate is 54·3 per cent. From 30 to 40 the rate is 13·8 per cent, with a fair expectancy of reaching 50 years. The survivors of this age number 18·8 per cent. The explanation may be taken reasonably as the more dangerous pursuits of the men (war and head-hunting) and the child-bearing of the women in the earlier period. In regard to differentiation of sex characters in the crania, males have greater cranial capacity, a longer, broader skull, and greater dolichocephaly than the females. They have also greater cranial height, a longer vertical arc and greater arcs over glabella, ophryon, and from nasion to opisthion; but in three respects, namely, nasal index, facial index and facial angle, the difference between male and female population is not so well emphasized. Comparison of craniometrical data from East Africa, Australia, New Guinea, and New Britain suggested a considerable admixture of Negro traits in the Pacific regions. There are mathematical grounds for believing in the probability that Tasmanians are an Australoid-Melanesian people.

War-time Mortality in London

The issue of the *Lancet* of April 20 contains an interesting study by Dr. Percy Stocks, medical statistical officer to the Registrar-General, of the mortality during the first seven months of the War, or more precisely from July 1939 until March 1940. He points out that a very substantial saving of life at ages under five years was the chief explanation of the remarkable fall in mortality from pneumonia, bronchitis, diarrhœa and whooping cough. Moreover, the expected epidemic of measles did not take place. Although children of school age did not benefit from school closure and dispersal to the same extent as children of pre-school age as regards mortality, deaths from diphtheria, measles and whooping cough sank to a very low level. On the other hand, during the winter period young adults showed a remarkable increase in mortality which was mostly caused by respiratory tuberculosis, respiratory diseases (other than pneumonia) and heart diseases, but the deaths from pneumonia did not increase appreciably during the severe weather. There was also a very decided increase in mortality among adults over 45 during the cold weather of January and February, mainly due to respiratory and heart diseases, but the proportionate increase in pneumonia was much less than that for influenza, bronchitis and other respiratory diseases. In conclusion, Dr. Stocks shows that under black-out conditions the increase in deaths due to this cause was least in the weeks when there was a full moon and most serious during the two preceding weeks.

Bird Migration and Gonad Development

From certain experiments, Rowan concluded that birds released when their gonads were at winter minimum or spring maximum showed no inclination to migrate, and that migration was associated with recrudescence or regression of gonads. The suggestion has been tested by Albert Wolfson, who contrasted experimentally the actions of migratory and resident races of juncos (*Condor*, **42**, 93, March–April 1940). The experiments were carried on over two years, and were devised and executed with thoroughness. Juncos were trapped before the period of migration, and were kept in large cages until the wild migrants had departed and were nesting and probably incubating in their northern breeding haunts. Histological examination of samples of the retained birds showed that by this time the gonads were fully developed. When released the resident and migratory races behaved differently; the former remained and were constantly recaptured in the neighbourhood, the latter disappeared, and were not seen or recaptured until the time when the wild migrants returned in the following autumn. Rowan's theory, therefore, does not meet the case, and the author, in a series of critical comments on Rowan's experiments and conclusions, indicates just where in his opinion these failed to give an accurate interpretation.

Parthenocarpy

Considerable practical importance is attached to the fact that the ovaries of various fruits may be stimulated to development by foreign pollen quite incapable of effecting fertilization, so that seedless fruits may result. Sadao Yasuda has been studying this subject since 1928 and has recently published a general account of his experiments (*Mem. Fac. Sci. and Agric.*, Taihoku Imperial University, **27**, No. 1; Dec. 1939). Ovaries of egg plants gave fruit with Petunia pollen but the reciprocal cross is without effect; similarly tomatoes arose from action of the pollen of the egg plant but the reciprocal cross would not work. Various combinations were thus tested, and successful combinations for parthenocarpic fruits showed no connexion with the systematic position of the plants. It was shown that if pollen could germinate and the tubes penetrate deeply into the style, parthenocarpy resulted. The growth of the pollen tubes seems influenced by a special substance in the style; this substance is produced originally in the ovary, a point checked by ingenious experiments with grafted styles. Where the pollen tube can influence ovary development the effect is produced before the tube reaches the ovary; it is only necessary that the tube should penetrate deeply into the style. Ovaries can grow into seedless fruit if injected with extracts of suitable pollen grains. Pollen grains of the proper species, too old to fertilize ovules and give seeds, may still contain this fruit-producing stimulus and may thus induce seedless fruit production.

Origin of Wheat

S. N. PATHAK (*J. Genetics*, 39, 437–467 ; 1940) has examined cytologically several species of Triticum, Ægilops, Secale, and Oryza. The morphology of the chromosomes shows that *T. monococcum* and *T. Ægilopoides* alone contain two pairs of *Sat* chromosomes—all the other species had one pair of these chromosomes with secondary constrictions in common. The number of nucleoli corresponds to the number of secondary constrictions and satellites: there are four in the diploid and tetraploid and six in hexaploid species of Triticum and Ægilops and two in diploid *Secale cereale*. The presence of four satellites and a quadrivalent in *T. monococcum* indicates that the basic chromosome number 7 is a derived one. Five is believed to be the original basic number of this group of species. It is suggested that *Triticum vulgare* may have resulted from a cross between *Ægilops squarrosa* and a tetraploid wheat. It is shown that one of these, *Triticum durum*, has dissimilar chromosome sets corresponding to the *A* and *B* genoms and has probably been derived from a diploid Triticum species with one pair of *Sat* chromosomes and an Ægilops species having secondary constrictions.

Seed Coat Colour in the Bean

H. A. K. LAMPRECHT (*Hereditas*, 26, 65–99, 279–304; 1940. *Z.I.A.V.*, 77, 186–194) describes the genetics of the various colours and markings of the seed coat of *Phaseolus vulgaris*. The striped, marbled and sprinkled coat colours are shown to depend on the multiple allelomorph series *Rrs-Rma-Rst-R-r*. The genes formerly designated *M* and *S* are thus shown to be allelomorphic with *R* and *r*; linkage tests show that the *R* series is strongly linked with the seed coat colour gene *C*. Heterozygous *Cc* or heterozygous *Rr* seeds are marbled and are naturally inconstant. Several genes, *Arc*, *Bip*, *diff*, and *exp*, have been found to affect the distribution of colour. They show incomplete dominance, therefore intergrading types are frequent. Dots of colour on the seed coat is due to a recessive gene *punc* or to a dominant gene *Mip*. The latter controls the distribution of colour around the micropyle. Rough seed coat is due to a recessive *asp*. The recessive gene *mar* causes the presence of a ring of colour around the hilum when another gene *j* is present. It is shown that *mar* always causes the appearance around the hilum similar to that of *J*. Thus recessive *j mar* simulates the effect of dominant *J* in that region.

Linkage Studies in Barley

D. W. Robertson and O. H. Coleman (*J. Genetics*, 39, 401–410 ; 1940) describe two new chlorophyll-deficient seedling types in barley which are determined by the genes *or* and *y* respectively. These genes are placed by linkage experiments in group I with cross-over percentages of *or-f* 8·69, *f-y* 0·81, *y-v* 31·27 (*f* gives chlorina seedlings and *v* gives six-rowed barley). Therefore, three seedling lethal factors are placed close together and at some distance from the non-six-rowed – six-rowed determining gene.

Smut Fungi of the Sugar-Cane

THE taxonomy of smut fungi which attack the sugar-cane has been somewhat uncertain in the past. Dr. B. B. Mundkur has, however, recently studied a considerable range of fresh and herbarium specimens of the fungi, and reaches the conclusion (*Kew Bull.*, No. 10 ; 1939) that the smut upon the culms of sugar-cane consists of one species, *Ustilago scitaminea*, and two new varieties, *U.s. Sacchari-Barberi*, and *U.s. Sacchari-officinarum*. Detailed descriptions of these organisms, and of *U. consimilis*, which also occurs upon the same host, are given.

Photochemical Oxidation of Hydrogen

AN investigation of the photochemical oxidation of hydrogen in hydrogen-oxygen mixtures with light of 1719–1725 A. at 1140–95 mm. pressure, by H. A. Smith and A. Napravnik (*J. Amer. Chem. Soc.*, 62, 385 ; 1940), shows that, with increasing oxygen content, the quantum yields of ozone increase while those of hydrogen peroxide and water decrease. At lower pressures the formation of water shows chain characteristics. The formation of ozone has a negative temperature coefficient in the range 25°–280°, while the temperature coefficients for the formation of water and hydrogen peroxide are positive and may increase with great rapidity above 230°. The results are interpreted on the assumption that the primary photochemical reaction is $O_2 + h\nu = 2O$, followed by interaction of oxygen atoms with oxygen and hydrogen molecules, the first by triple collisions: $O + O_2 + M = O_3 + M$, and the second by triple collisions with an oxygen molecule as third body: $O + H_2 + O_2 = H_2O + O_2$. The possibility of hydrogen as the third body is not excluded. The oxygen atoms may also react with hydrogen molecules: $O + H_2 = OH + H$, the hydroxyl radicals reacting with hydrogen to form water and atomic hydrogen: $OH + H_2 = H_2O + H$. The atomic hydrogen reacts with a mixture of hydrogen and oxygen at room temperature to form hydrogen peroxide, first forming HO_2 by a triple collision: $H + O_2 + M = HO_2 + M$, and the HO_2 may react in the gas phase or on the walls to form hydrogen peroxide: $HO_2 + HO_2 = H_2O_2 + O_2$.

New Supernovæ

DR. J. JOHNSON of the California Institute of Technology reports from Mount Palomar the discovery, on a photograph of February 16, 1940, of "a new object, star-like, not moving, about 13th magnitude, located at the southern tip of the edge-wise spiral NGC 5907". Plates taken with an 18-in. Schmidt camera on February 18 and March 1 confirm the reality of the object, which is presumably a supernova. The parent nebula is well placed for northern observers now and for the next three or four months. Harvard Announcement Card 519 helps in fixing the time of outburst by stating that at the position given no object brighter than magnitude 14·6 shows on the patrol plates of February 3, and none brighter than magnitude 13·2 on February 11. Dr. F. Zwicky reports that he has found a supernova of apparent magnitude 16 on a film taken with an 8-inch Schmidt telescope on Palomar Mountain on December 4, 1939. It is in the spiral nebula at R.A. 0h. 54m., S.Dec. 5° 20′ (1939·0) and is about 16″ north-west of the nucleus. It is presumed that it attained a maximum brightness, mag. 15, on November 20. The spiral in which it appears is estimated to be seven million parsecs distant.

VOLCANISM IN FRENCH SOMALILAND

M. E. AUBERT DE LA RÜE has recently travelled extensively in French Somaliland (November 1937–May 1938) for the purpose of conducting field work, which he has since examined critically (*Bull. Volcanolog.*, ii, 5, 71–108; 1939). It is very plain from the report that volcanism has had an important role in the building up of this region of tropical Africa near the Gulf of Aden. At the moment there is no active volcano in the land but in numerous places there are fumeroles and hydrothermal springs which are the last stages of volcanic activity. In order of age (oldest first) the volcanism may be roughly classified as: (1) Old Basaltic Series, (2) Rhyolitic Series, (3) Recent Basaltic Series, (4) very recent eruptions, and (5) present day volcanic phenomena which include (*a*) fumeroles and (*b*) thermal springs.

The Old Basalts in the form of dykes and lava flows were incident after the deposition of the Infracretaceous sandstones. They were observed by M. Dreyfuss in the Ali Sabien mountain complex and they have been observed in the Mabla mountains by M. Dreyfuss and M. Teilhard de Chardin. M. E. Aubert de la Rüe has been able to identify them over a much wider area. In the Issa area they form the base of the Guelileh Valley, and they may be seen under the rhyolite flows of the dissected plateau of Damer-Kada. The Boura mountains, previously considered entirely rhyolitic, in reality have a basaltic base which in places attains an altitude of 750 metres and which is surmounted by tuffs and rhyolitic lava flows. In the Dankali area the Old Basalts appear at the base of the rhyolitic Hassa-Ali chain. They are to be found at the entrance to the Orgoïta Ravine at the foot of the Yagueri Mountains a little to the north of the Yoboki Pass. The series from the base upwards consists of Old Basalt, greenish rhyolitic tuff, rhyolitic obsidian, and rhyolite. In places the basalts attain an altitude greater than 1,000 metres. This is so in the high valley of Magaleh and at the col Adhali-Daba to the north of Tadjourah, where they reach a height of 1,140 metres. This Old Basaltic Series is often greatly altered, containing siliceous concretions, calcite veins, zeolites, stillbite and heulandite. When not decomposed the basalt presents a very varied appearance in different localities.

The Old Basalts are followed by the Rhyolitic Series, the age of which is uncertain because there are no sedimentary rocks interstratified with them. M. E. Aubert de la Rüe has been able to show that at least in some places the rhyolites were produced before the basaltic eruptions had ceased. One such case is in the Mabla Mountains where, under the path from Letabolo to Baté-Ero, one can see a rhyolite flow about 10 m. thick between two basalt flows. The Rhyolitic Series may be observed throughout the colony, and does not appear to have a greater thickness than 500 m. The rhyolites, in places prismatic and very fresh, are elsewhere frequently altered. The obsidians are opaque or translucent, grey, grey-green, or black, the latter often having been mistaken for coal. Pantellerite and comendite, described by Lacroix and Arsandaux, have been found near Hol-Hol and in the Mabla Mountains.

The lava flows may be compared with the 'coulees stratoïdes' of Yemen described by M. P. Lamare, and have often been eroded into extremely steep pitons. The centres of eruption are most difficult to determine and the different 'Massifs' are regarded not as the vestiges of ancient volcanoes as in the region near Aden but as the remains of rhyolitic plateaux. This agrees with the opinion of P. Lamare, to whom the Mabla massif appears to be a horst.

The rhyolitic series is followed by the Recent Basaltic Series, but in between the deposition of the two was a long interval of time during which a good deal of erosion took place. This may be seen at a number of places but particularly in the valley of Magaleh in the Goudah massif where the whole sequence may be observed. The Recent Basaltic Series appears to be due to a series of fissure eruptions which took place with great regularity. Here and there, between two of the lava flows there exists a well-cemented, reddened conglomerate usually containing pebbles of basalt but sometimes pebbles of rhyolite. The series is fairly uniform, fine grained, and generally having a doleritic texture. It nearly always contains olivine but never in great quantities. Occasionally it is porphyritic with large phenocrists of plagioclase. Some Andesitic flows, chiefly in the Arta massif and near the Koranke-Hada-E-Kouri-Djabet Mountain, accompany the Recent Basaltic Series. The thickness of the lava in the flows usually varies from 3 m. to 5 m. There are no intercalated tuffs to separate the flows but Aubry found in the Assal Basin under 200 metres of labradorite a lacustrine sedimentary deposit with Unio, Corbicules, Limnées, Planorbes and Mélanies about three metres thick. Similar phenomena have been observed elsewhere in the colony. The smallish volcanic cones visible from Djibouti in the region to the south-west have been formed by scoriaceous lavas and are of mixed Strombolian–Hawaiian type. Perhaps Mount Garbi is a volcanic cone, and if so it is the largest in French Somaliland (1,650 m.).

It is difficult to draw a demarcation line between the Recent Basaltic Series and the very recent eruptions, but it is probable that man was already on the earth when the volcanoes of Ghoubet-el-Kharab erupted. The basaltic flows, interstratified with the Quaternary cones of dejection at the lower end of the slopes of the Mabla Mountains, are probably fairly recent and have been affected by very recent faults in the valley of west Ababoléï. The last stages of volcanic activity may be found in the fumeroles and hot springs now existing. A typical fumerole is in the south-east of the plain of Hanleh about 3 km. 500 m. to the east-north-east of Garbes. It is called by the Danakils 'the smoking mountain' and consists of a band a few score metres wide and about 400 metres long orientated in a north-west–south-east direction. In this region the basalt has been largely decomposed to a red clay which is often at a temperature of 100° C. Aqueous sulphurous vapour at 100° C. escapes from the ground through a multitude of small fissures sometimes silently and at other times with a slight whistle. Near the region there are incrustations of white gypsum, saccharoïde and kalinite.

There are numerous regions with hot springs in the colony. A typical one is at Asbahalto on the eastern bank of Lake Abbé, called by the Danakils 'the evil smelling water'. Here innumerable thermal springs have deposited walls of travertin which have the appearance of ruins, about 5–10 m. high on the average. This travertin is composed chiefly of calcium carbonate together with a little magnesium carbonate. Superficially it is clear grey whilst in the interior it is yellowish white, having a spongy structure and being somewhat friable. The denticulated walls and small pitons are aligned roughly east-west and probably follow the fault lines. A spring at the foot of Badikoma has a temperature of 100° C., gave a fairly alkaline reaction and when evaporated left a residue of 2·48 gm. per litre. This consisted of silica 0·090 gm., calcium carbonate 0·109 gm., calcium sulphate 0·485 gm., magnesium chloride 0·032 gm., potassium chloride 0·054 gm., sodium chloride 1·648 gm., sodium bromide 0·0035 gm., together with organic and miscellaneous material 0·0585 gm. Other hot springs abound in the plain of Hanleh, in the valley of west Kouri, in Goum, Halol, and in Obock.

FOREST PRODUCTS RESEARCH BOARD

THE report for 1938 of the Forest Products Research Board recently issued (London: H.M. Stationery Office, 1939. 1*s.* 6*d.* net) is dated June 1939. Remembering that the outbreak of war was to come so soon after its completion, there are one or two points which appear to merit particular mention. The chief, perhaps, is the research on composite wood, for which the Board had had under consideration detailed proposals for the provision of equipment.

The interest which this subject has aroused would seem to indicate that all the substitutes which have replaced wood have apparently had little influence upon the great demands still being made on the forest. The Board's report states, with reference to composite wood: "We are impressed with the need for systematic research on the properties of this class of materials in order to build a foundation of technical knowledge such as has been accumulated in the case of 'solid' wood by many years of work at various universities and laboratories in the past." In view of the importance which the processes of manufacture and the interrelations of the materials used have on the properties of the final products, the need for systematic research is evident. New methods of test and investigation may have to be developed to deal with these products, the properties of which differ fundamentally from those of 'solid wood'. Inquiries regarding these products were rapidly increasing, even though the laboratory has disclaimed possession of any real technical knowledge of them. The industries interested cover every field in which natural wood has hitherto been used, and several in which the use of wood has practically been abandoned.

The report of the Director of Forest Products Research is issued with the above. Inquiries in every department of the Laboratory's activities continued to be numerous. As one example of the work undertaken, the experimental work on the production of charcoal in portable steel kilns is proving successful. Charcoal is being increasingly used for various industrial purposes, particularly in the manufacture of Rayon; and the manufacturer in Great Britain has been very dependent on foreign supplies of it. Hitherto, charcoal which has been made in portable kilns has contained too great a percentage of volatile matter; the experimental kiln now in use is said to go far in removing this objection. A leading firm of Rayon manufacturers has stated that charcoal produced by certain burnings is equal to the best obtainable from any source.

CORTICAL LOCALIZATION OF INTELLIGENCE

H. M. HILDRETH, at the meeting of the American Association for the Advancement of Science, Columbus, Ohio, December 1939, presented a statistical study of the cortical localization of intelligence.

The problem involves the correlation of an independent physiological variable with a dependent psychological variable. Since in studying human beings it is not possible to destroy predetermined parts of the cortex by operation, an experimental group of individuals whose brains had been damaged by disease or by natural organic changes had to be used. The psychological variable could be measured by using well-established tests of intelligence. The group studied consisted of individuals found to be suffering from cerebral arteriosclerosis, in which disease small areas, apparently occurring at random, are destroyed throughout the brain. From a psychopathic hospital of 4,000, all the patients who after complete examination were found to be suffering from this disease were selected, and from this group were eliminated those who showed signs of any disease, for example, brain tumour, that might conceivably affect intelligence. This gave a selected experimental group of 201 subjects. A control group of 201 normal individuals was also selected, comparable except that they had no signs of arteriosclerosis. Previous records of intelligence and school attainments were available.

It is argued that if all the subjects are now given an intelligence test, since the two groups are matched, then the performance of the normal group might be taken as what the other group would have been if it were not suffering from arteriosclerosis.

To find out the effect of the disease the two groups were compared in the various Binet tests, the frequency and percentage of each group passing the given tests being tabulated and the percentage of deterioration on each test calculated.

On the hypothesis that the ability to pass a given test is cortically localized, a randomly distributed deterioration would be expected. Such was not the case. The experimental findings supported the hypothesis that intelligence is a function of the whole brain, against the hypothesis of specific localization.

LONDON'S WATER DURING 1938

THE recently issued report of the Metropolitan Water Board* tells of the unceasing supervision exercised over London's water supply during 1938. The total output from the Board's works was 111,438 million gallons, a slight increase over the previous high record of 1937, the average daily supply to consumers being 312·77 million gallons, of which 65 per cent was derived from the Thames.

Some 50,000 samples were analysed during the year, of which about 30,000 were routine bacteriological, and 4,700 routine chemical, examinations, the main purpose of which is to determine that all the processes—storage, filtration, purification, distribution—are working satisfactorily so as to ensure a pure and safe supply to consumers. Based upon the *Bact. coli* test, 99 per cent of all samples were of first-class quality (absence of *Bact. coli* from 100 ml.) —a highly satisfactory record.

Of researches conducted in the Board's Laboratories, much attention has been directed to improving the *Bact. coli* test, and the method for isolating coliform organisms when present, for the purpose of differentiating the type. New procedures were also investigated for improving the method of isolation of *Clostridium Welchii* and the Streptococcus organisms that are sometimes of service for assessment of the potability of a water.

The occurrence of *Bact. paratyphosum* B, a microbe that causes a form of enteric fever, in Epping sewage has been noted since 1931. This specific organism is still present in the sewage, in fact was somewhat more numerous than it was in 1937, and as a precaution chlorination of the effluent has now been established as a permanent measure. Investigations on improved methods for the isolation of this organism are in progress.

Complaints are sometimes received concerning the taste of the water, and no less than 11,360 'taste' tests were carried out during the year by the expert tasters of the Board's staff. Complaints of taste are generally attributable to some defect at the works, the commonest being an overdose of chlorine. Earthy or musty tastes result from decomposition of, or fungoid growths in, filter bed skins during hot weather, and characteristic tastes are produced by decomposing plankton. In one instance, a musty taste occurred in the water drawn from the cold water tap in a kitchen, and was traced to two species of fungi growing in the tap. Organisms belonging to the Actinomyces are capable of producing earthy tastes, and this subject is under investigation.

Certain algæ and diatoms are subject to periods of sudden excessive growth, and are liable to cause trouble in reservoirs and filter beds. Thus, it was reported that a 'brown' growth had arisen in one of the reservoirs, and microscopical examination showed that this was caused by excessive growth of a diatom, *Stephanodiscus Hantzschii*, which was clogging the secondary filter beds. By treatment with alum this trouble was overcome. Investigations are being carried out in the Biological Section with the view of ascertaining the cause of these fluctuations in the number of the algal and other living forms in the water; they may depend upon peculiar variations in the silica, phosphates and other mineral constituents of the water which are known to take place at certain seasons of the year. An account is given of the appearance in a reservoir of *Oscillatoria rubescens*, a blue-green alga, and of the chemical conditions prevailing. In August when this organism became very numerous, *p*H values were higher, temporary hardness was lower, and concentrations of PO_4 were rising rapidly to a very high level compared with March, when the organism was scanty.

Notes are given on the occurrence of certain rare Copepods and other forms of microscopic life, numerous tables are included, and the report is illustrated with several excellent plates.

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* Metropolitan Water Board. Thirty-third Annual Report on The Results of the Bacteriological, Chemical and Biological Examinations of London Waters for the Twelve Months ended 31st December, 1938. By Lt.-Col. E. F. W. Mackenzie, Director of Water Examination, Metropolitan Water Board. (P. S. King and Son, Ltd., 14 Great Smith Street, Westminster.) 10*s*. 6*d*.

ECONOMICS OF WAR COSTS

THE problem of paying for the War is discussed in an Oxford Pamphlet on World Affairs (Oxford: Clarendon Press. 3*d*. net) by G. Crowther and a broadsheet issued by Political and Economic Planning (P E P), which have both appeared under that title. The real problems of paying for the War, the broadsheet points out, are economic, political and psychological; for the limits of war effort are not financial but social, psychological and economic. The size of the output of war material depends on the willingness of people to work harder and make their capital resources last longer, and above all, on the way they react to reductions in their standards of life. The methods of financing the War are vitally important, since they determine the distribution of its cost between different groups of people and may have a profound effect upon the distribution of income after the War. The best method can only be decided after a careful examination of social claims and resistances, and once the method is decided financial technique can be used to implement policy.

The P E P broadsheet, taking the national income of Great Britain as £5,700 millions, and the current national expenditure at more than £2,500 millions, points out that the increased revenue must be drawn from increased production, the use of overseas assets and the diversion of output. Mainly it will be a burden for the present. Diversion of output from capital maintenance is estimated as offering savings from £300 to £500 millions, while for the diversion of resources from the production of goods for private consumption varying estimates are given. The four main methods by which the Government can gain control over the resources which it needs are taxation, borrowing, through the medium of the price mechanism and by direct Government control.

In regard to taxation, the broadsheet points out that the bulk of additional income tax revenue must come from the middle incomes, where its incidence is comparatively light, and the importance of devising a comprehensive family allowance scheme is stressed. Reviewing other taxation possibilities, the scope for a tax on luxuries is indicated ; the inevitable heavy taxation of those with low incomes will be resented unless the Government makes it quite clear that those who are comfortably or luxuriously off are being taxed in earnest. Discussing Mr. Keynes' proposals for forced saving by paying a proportion of all wages and salaries in the form of a blocked deposit not available for spending until after the War, the broadsheet points out that the scheme offers a means of preventing standards of living from rising, or of reducing them without incurring major political opposition. Further research into the limits of the voluntary type of saving is also required.

In regard to borrowing, the raising of loans directly from the public is not inflationary, but borrowing from the banks is almost bound to be inflationary. This is the third method by which the Government can gain control of the requisite resources, and both the broadsheet and Mr. Crowther point out the objections to inflation. Mr. Crowther urges that we should first concentrate on raising taxation to the highest supportable level on rich and poor alike. We should then see what could be done by rationing to increase the genuine savings that can be borrowed. Only when we have exhausted these deliberate and scientifically planned devices should we turn to the haphazard, incalculable and inequitable method of inflation. Certain measures of Government control over the economy are an indispensable adjunct to inflation, such as price control and its corollary rationing.

Mr. Crowther argues that the fundamental task of war finance is to transfer resources from consumption to the purposes of war, and he insists that, while totalitarian war cannot be financed entirely out of taxation, the only taxes likely to bring in sums substantial enough to contribute to avoidance of inflation are not confiscatory taxes on the rich or fancy taxes on profiteers, but plain honest taxes that hurt plain honest people. Moreover, since the real economic necessity of war is to reduce consumption, even after the ordinary man has paid his taxes, his consumption must be further restricted, either by voluntarily or compulsorily increasing his savings or through the cost of living rising against him.

SEVENTY YEARS AGO

Nature, vol. 2, May 26, 1870

The Admiralty have acceded to the request of the Royal Society by again placing Her Majesty's surveying steam-vessel the *Porcupine* at their disposal for another deep-sea expedition. A photometric apparatus has been contrived by Mr. Siemens to ascertain the depth to which solar light penetrates the sea.

The Duke of Devonshire, the Marquis of Lansdowne, Sir John Lubbock [Lord Avebury], Sir James Kay-Shuttleworth, Bernard Samuelson, Dr. W. Sharpey, Prof. T. H. Huxley, Prof. W. A. Miller and Prof. [Sir] G. G. Stokes have been appointed to make inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from grants voted by Parliament or from university and college endowments, and whether such aid could be made more effectual.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned :

Temporary Lecturer (woman) in Education and Psychology—The Principal, Municipal Training College, Cottingham Road, Hull (May 30).

Lecturer in Mathematics, and a Senior Mistress for the Day School—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (May 31)

Head of the Women's Department of the Blackpool Technical College—The Director of Education, Education Offices, Stanley Buildings, Blackpool (May 31).

Head of the Chemistry Department—The Principal, Municipal Technical College, Hopwood Lane, Halifax (May 31).

A Representative to superintend and co-ordinate the work of the British Council in Bulgaria, Rumania and Yugoslavia—The British Council, 3 Hanover Street, W.1 (June 1).

Two Teachers (men) of English for Yugoslav-British Institute Belgrade—The British Council, 3 Hanover Street, W.1 (quoting 'Belgrade') (June 1).

Lecturer in Biology—The Secretary, Technical College, Sunderand (June 3).

Lecturer (male) of Physics—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7 (June 3).

Assistant Woman Graduate for Commercial Geography in the Schools of Technology, Art and Commerce, Oxford—The Chief Education Officer, Education Offices, 77 George Street, Oxford (June 4).

Male Lecturer in English at Oporto University, Portugal—The British Council, 3 Hanover Street, W.1 (quoting 'Portugal') (June 5).

Head of the School of Architecture and Building—The Registrar, School of Architecture and Building, College of Arts and Crafts, Leicester (June 7).

Inspector, Southern Education—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1, (quoting 'Inspector, Southern Education') (June 15).

Mathematical Tutor in the Khartoum Secondary School—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Mathematical Tutor') (June 15).

Lecturer in Chemistry in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Lecturer in Chemistry') (June 15).

Lecturer in Electrical Engineering, and a Lecturer in Mechanical Engineering, at the School of Engineering, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (quoting 'Lecturer in Electrical or Mechanical Engineering') (June 15).

Head of the Chemistry Department—The Clerk to the Governors, Technical College, Normanton Road, Derby (June 15).

Curator of the Museum and Art Gallery—The Town Clerk, Town Hall, Leicester (endorsed 'Curator') (June 17).

Chief Fisheries Officer, Palestine—The Director of Recruitment (Colonial Service), 29 Queen Anne's Gate, S.W.1 (June 22).

Teacher of Physics at the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Clifton Road, Rugby.

Temporary Graduate Assistant (man or woman) to teach Physics at the County Technical College, Dartford—F. L. Notley, 11 Essex Road, Dartford.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Saturday, May 25

BRITISH PSYCHOLOGICAL SOCIETY (at 55 Russell Square, W.C.1), at 3 p.m.—H. W. Durant: "A Critical Account of Public Opinion Measurement".

At 5.30 p.m.—J. G. W. Davies: "Individual Differences between Psychological Workers".

At 6.15 p.m.—Alec Rodger and Patrick Slater: Report on "Some New Non-verbal Tests".

Monday, May 27

ROYAL GEOGRAPHICAL SOCIETY, at 5 p.m.—A. Stephenson: "Graham Land and the Problem of Stefansson Strait".

Tuesday, May 28

ROYAL INSTITUTION, at 5.15 p.m.—Prof. V. H. Mottram: "Food and the Housewife".*

Thursday, May 30

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY, at 2.30 p.m.—Physical and Biological Experiments with Neutrons. Dr. John Read: "The Production and Measurement of Neutron Radiation at the Mount Vernon Hospital"; Dr. F. G. Spear: "A Comparison of the Biological Effects of Neutrons and Gamma Rays"; J. C. Mottram: "The Action of Neutrons on the Growth of Bean Roots and upon the Mitosis of Bean Root Cells"; Dr. L. H. Gray: "Survey of Results so far Obtained by Different Workers"; Discussion.

At 6.30 p.m.—Annual General Meeting.

AUSTRIAN ACADEMY IN GREAT BRITAIN, at 5 p.m.—Prof. Dr. Ernst Freund: "Austria's Contribution to the Solution of Cancer Problems".

Friday, May 31

ROYAL INSTITUTION, at 9 p.m.—Prof. W. W. C. Topley, F.R.S.: "Bacteria in the Air".

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

St. Thomas's Hospital Reports. Edited by Prof. O. L. V. S. De Wesselow and C. Max Page, assisted by N. R. Barrett, Dr. J. St. C. Elkington and Dr. A. J. Wrigley. Second Series, Vol. 4. Pp. 198. (London: St. Thomas's Hospital.) 10*s*. [15

The College of the Pharmaceutical Society. Annual Report of Research Work, 1939. Pp. 46. (London: Pharmaceutical Society.) [15

Institution of Professional Civil Servants. Annual Report for the Year 1939. Pp. xii+74. (London: Institution of Professional Civil Servants.) [15

Department of Scientific and Industrial Research. The National Physical Laboratory Report for the Year 1939. Pp. iv+100. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [15

University of London: University College. Annual Report, February 1939–February 1940. Pp. 54. (London: Taylor and Francis, Ltd.) [15

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1939. Pp. 32. (York: Yorkshire Museum.) [35

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 4: Some Ecological Aspects of the Intertidal Area of the Estuary of the Aberdeenshire Dee. By Dr. Alec Milne. Pp. 107–139+2 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 5*s*. [35

Ministry of Health. Emergency Medical Series, Memorandum No. 3: Procedure on the Admission, Transfer, Discharge or Death of Casualties, and for the Provision of Out-patient Treatment. Second edition. Pp. 27. (London: H.M. Stationery Office.) 6*d*. net. [35

A New Map of the Karakoram: with Range and Peak Names approved by the Karakoram Conference 1937. Drawn by F. J. Batchelor under the direction of Prof. Kenneth Mason. Scale 1 : 750,000 or 11·8 miles to 1 inch. 22·7 in. × 20 in. (London: Royal Geographical Society.) 7*s*. 6*d*.; 5 rupees. [35

John Innes Horticultural Institution. Thirtieth Annual Report for the Year 1939. Pp. 20. (London: John Innes Horticultural Institution.) [85

Annual Report of the Oundle School Natural History Society, 1940. Pp. 32. (Oundle: Oundle School.) [85

Other Countries

India Meteorological Department. Scientific Notes, Vol. 8, No. 86: Determination of Visibility at Night with the help of Wigand's or Bennett's Visibility Meter. By A. K. Roy. Pp. 23-30. 5 annas; 6*d*. Scientific Notes, Vol. 8, No. 87: A Discussion on some Aeroplane Ascents at Drigh Road (Karachi) on days of Duststorms, Thunderstorms and Dust Raising Winds. By B. N. Desai and S. Mal. Pp. 31–46. 8 annas; 9*d*. (Delhi: Manager of Publications.) [15

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 31: Studies in the Preservation of Fruits and Vegetables; an Investigation on the Methods of Preparation and Standardization of Tomato Ketchup. By Lal Singh and Dr. Girdhari Lal. Pp. 12+1 plate. (Delhi: Manager of Publications.) 7 annas; 8*d*. [15

Union of South Africa: Department of Agriculture and Forestry. Science Bulletin No. 201 (Chemistry Series No. 157): Compost, its Preparation and Use; the Conversion of Agricultural "Waste Material" into Synthetic Manure. By Dr. E. R. Orchard. Pp. 28. 3*d*. Bulletin No. 212 (Chemistry Series No. 159): Removal of Sooty Blotch from Oranges. By C. P. Maude. Pp. 14. 3*d*. (Pretoria: Government Printer.) [15

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 11: 500 Books for Children. By Nora E. Beust. Pp. vi+90. (Washington, D.C.: Government Printing Office.) 15 cents. [15

Indian Forest Records (New Series). Botany, Vol. 1, No. 6: Notes on some Indian Species of *Lactuca*. By Dr. G. Ledgard Stebbins. Pp. 237–246+1 plate. (Delhi: Manager of Publications.) 8 annas; 9*d*. [35

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Tests on the Liquefaction of Canadian Coals by Hydrogenation. By T. E. Warren and K. W. Bowles. (No. 798.) Pp. vii+106. 25 cents. Comparative Tests of Various Fuels when Burned in a Domestic Hot-Water Boiler, 1935 to 1938. By C. E. Baltzer and E. S. Malloch. (No. 802.) Pp. v+24. ·25 cents. (Ottawa: King's Printer.) [35

U.S. Department of the Interior: Bureau of Biological Survey. Conservation Bulletin No. 1: Attracting Birds. By W. L. McAtee. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [75

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 45, Part 2: New Species and Genera of *Cercopidæ* in Japan, Korea and Formosa, with a List of the Known Species. By Shonen Matsumura. Pp. 35–82+3 plates. (Tokyo: Maruzen Co., Ltd.) [75

Indian Forest Records (New Series). Entomology, Vol. 6, No. 2: Some *Cleridæ* from India, Burma and Ceylon, with Descriptions of New Species and Notes on Others. By J. B. Corporaal. Pp. ii+17–40. (Delhi: Manager of Publications.) 14 annas; 1*s*. 3*d*. [75

Pasteur Institute of India, Kasauli. The Thirty-eighth Annual Report of the Central Committee of the Association and the Audited Accounts up to September 30th, 1939, also the Report of the Director of the Institute. Pp. 45. (Kasauli: Pasteur Institute of India.) [75

Field Museum of Natural History. Botanical Series, Vol. 9, No. 4: Flora of the Aguan Valley and the Coastal Regions near La Ceiba, Honduras. By Prof. T. G. Yuncker. (Publication 466.) Pp. 243–346. 75 cents. Botanical Series, Vol. 21: Travels of Ruiz, Pavón and Dombey in Peru and Chile (1777–1788). By Hipólito Ruiz. With an Epilogue and Official Documents added by Agustín Jesús Barreiro. Translation by B. E. Dahlgren. (Publication 467.) Pp. 372. 3.50 dollars. (Chicago: Field Museum of Natural History.) [75

Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series A, Vol. 2: Oceanography. Part 2: Tidal Observations. By Dr. A. T. Doodson. Pp. 61–86+3 plates. 4*s*. Part 3: Soundings. By John K. Davis. Pp. 87–102+2 plates. 2*s*. 6*d*. Part 4: Hydrological Observations made on board S.Y. *Aurora*. Reduced, tabulated and edited by Sir Douglas Mawson. Pp. 103–126. 3*s*. Part 5: Marine Biological Programme and other Zoological and Botanical Activities. Compiled by Sir Douglas Mawson. Pp. 127–168+9 plates. 7*s*. 6*d*. Series B, Vol. 5: Meteorology. Part 1: Records of the Queen Mary Land Station; Part 2: Meteorological Log of S.Y. *Aurora*; Part 3: Sledge Journey Weather Records; Appendix, Macquarie Island Weather Notes for 1909, 1910, 1911. Pp. x+282+4 plates. 40*s*. (Sydney: Government Printer.) [75

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. No. 89: La transgression albienne et cénomanienne dans le Hainaut (Études paléontologiques et stratigraphiques). Par Dr. René Marlière. Pp. 440+8 plates. No. 90: Les tabulés du dévonien moyen et supérieur du Bord Sud du Bassin de Dinant. Par Dr. M. Lecompte. Pp. 230+23 plates. No. 93: Végétaux éodévoniens de la Belgique. Par F. Stockmans. Pp. 90+14 plates. Deuxième série, Fasc. 15: Résultats scientifiques des croisières du navire-école belge *Mercator*, Vol. 2. Pp. 218. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique.) [75

Anthropological Records. Vol. 2, No. 4: Southern Paiute Shamanism. By Isabel T. Kelly. Pp. ii+151–168. 25 cents; 1*s*. 6*d*. net. Vol. 2, No. 1: The 1870 Ghost Dance. By Cora Du Bois. Pp. vi+152. 1.50 dollars; 9*s*. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [85

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 234: Contribution to the Flora of Egypt—Plants collected from Southern Sinai in April 1937. By J. R. Shabetal. Pp. ii+84. (Cairo: Government Press.) P.T. 8. [95

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"THIS FREEDOM"

THE menace to freedom of thought and learning not merely in Europe but throughout the world has grown unmistakably graver with the latest advances of ruthless aggression. In Belgium and Holland pitiless destruction is spreading in countries which possess traditions representing even more richly than German history the most colourful, creative and imaginative phases of European life. To the lengthy list of centres of learning where creative thought and independent inquiry and research have already been proscribed there are now to be added such names as Brussels, Leyden, Louvain.

No one who has the least appreciation of the debt which science alone owes to research at Vienna, Prague, Warsaw, Cracow, Copenhagen or Oslo can contemplate without dismay the further extension of the list of those centres of learning whose work has in this way been closed down or stultified. "Achievement in science," as Raymond B. Fosdick, president of the Rockefeller Foundation, remarks in his review for 1939*, "more often than not is the result of the sustained thinking of many minds in many countries driving towards a common goal. The creative spirit of man cannot successfully be localized or nationalized. Ideas are starved when they are fenced in behind frontiers. The fundamental unity of modern civilization is the unity of its intellectual life, and that life cannot without disaster be broken up into separate parts."

It is well indeed that the president of the Rockefeller Foundation should refer so plainly to the disastrous consequences even to the intellectual life of America which would follow from the interruption, or suspension for half a decade, of the fundamental activities of the universities and laboratories of Europe as a result of exhaustion or chaos through the War. The onslaught on Holland and Belgium has a further significance. Beyond the achievements in politics and culture of the Low Countries, these peoples, now under German rule, have in the past given noble service to the cause of liberty. Twice at least in history the effort of the Dutch was decisive in the struggle against the domination of Europe, while in recent years both Holland and Belgium have brought to modern politics the best qualities of that city life which stirred the imagination of the Middle Ages and the Renaissance. They have built up communities in which democratic self-government is respected as an ideal and practised as a mode of life.

The passion for liberty and the belief in toleration live no less ardently in the hearts of these peoples to-day, as their heroic resistance has borne witness. What is new in the situation is the comparative inefficacy of that intellectual or moral resistance to-day in the face of the immense material power which can be exerted by a nation barbarous enough to turn its whole national economy to preparation for war, and ruthless enough to disregard all the generous principles and traditions upon which Western civilization is based. As Edouard Herriot reminds us in the "Wellsprings of Liberty", to-day it is imperative to recognize that "Thought and action are two sisters who must never be separated".

For scientific workers, the stirring lines of J. R. Lowell's Harvard Commemoration Ode are as pregnant with meaning in the present struggle as when they were first recited seventy-five years ago. Once again the service and quest for truth are no longer sufficient within the walls of a laboratory or university. They must be rendered over wide fields of national need under stress and strain and peril of life itself. Lowell's eloquent third stanza may well remind us that the struggle in which we are engaged is one which enlists the sympathy and goodwill of all those who are concerned with the quest for truth, the patient, unprejudiced unravelling of the secrets of Nature, the maintenance of learning, of freedom of investigation, and of creative thought, whatever their nationality.

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* The Rockefeller Foundation. A Review for 1939. By Raymond B. Fosdick. Pp. 72. (New York: The Rockefeller Foundation, 1940.)

That the reality of the challenge to the finest values in our intellectual heritage is recognized as frankly in the United States as in Europe is shown beyond question in Dr. Fosdick's review. In an admirable passage he traces the intimate relation of European and American science and the interdependence of intellectual leadership. But he goes far beyond this. Pointing out that we are living in a world which threatens to brush aside everything that intelligence stands for, he brings us face to face with the real challenge of force.

Force, he insists, in the end always defeats itself. It appears to cut through the complexity and confusion without the necessity of the severe intellectual effort and discipline involved in the creation of an effective alternative. In the long run it solves nothing and answers nothing, and the surrender to force in practice, while rejecting it as an ideal, is one of the real tragedies of our times. The great society which science and culture have placed within our reach will not be achieved by the application of force, but by the persistent application of intelligence against the things that now dwarf our hopes. In the interdependent society we have created, the issues are no longer simple, individual and local; they are complex, social and world-wide, and beyond the experience of most of us. Money and credit, international relations, trade and finance, national income and its distribution, wages, profits, prices, purchasing power, savings and investment, employment, social security, collective bargaining, housing, propaganda, public administration, relations between Government and business, individual and social adjustment, social welfare, education, population—these are only a few of the urgent issues demanding creative and sustained intelligence for their solution.

With no less compromise than Lord Halifax in his address, the "Challenge to Liberty"*, Dr. Fosdick brings us face to face with the real issues involved in the present struggle. Lord Halifax sees the conflict between youth and youth through the acceptance of sharply differing standards of conduct in different countries. He sees that there is an active force of evil which unless fought and overcome will rapidly reduce our civilization to a desert of evil, and he insists that if we are to keep our bearings we must base ourselves firmly on social, moral and religious standards. If we are to recapture the secret of order for international society we must as individuals strive to erect or maintain standards that will bring true freedom through the way of discipline.

If the doctrine of force could be effectively put to shame the way would be open to concentrate the effort now mobilized for war upon the improvement of the common lot of man. What matters first is that we should desire not an easier but a better world, and equip ourselves in body, mind and spirit to create it. We must recognize that we have first to overcome the doctrine which denies the corporate claim to liberty of men and women organized in national societies and refuses the even more fundamental claim of men and women to the free expression of human personality, which rests upon the eternal value of every human soul. The future of humanity cannot be left in the hands of those who would imprison and enslave it.

It is well that the fundamental issues should be laid so clearly and unmistakably before us, not merely by British leaders but also by those in the other great Anglo-Saxon nation. If war jeopardizes our heritage and interrupts our normal intellectual activities, we must remember that it also affords fresh opportunities for creative work and reconstruction. As Miss Dorothy Sayers puts it, we can 'begin here' in the task of creating the new society if we are prepared to make the effort.

It is indeed on this note of opportunity that Dr. Fosdick concludes his review. In place of letting conflict degenerate into a mere fight for power, we can maintain the creative struggle for facts and ideas by vigorously supporting competent intellectual efforts to define and analyse the issues facing society. When by objective and competent study the issues are more precisely defined and the facts more exactly known, the conflicting views which still remain can, with reasonable good will, more readily be resolved. A firmer substructure for public and private policy will thus be provided, and the clear statement of the highly involved issues from the technical side is a first step to the clarification of the moral and ethical questions of to-day.

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* The Challenge to Liberty: an Address given at Oxford. By Viscount Halifax. Pp. 24. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 3*d*. net.

For such reasons, Dr. Fosdick considers that studies in the social sciences present an intellectual challenge of central importance; and his appeal for adequate support, for the development of the highly specialized and complex methods necessary by highly skilled men and women working under the most favourable conditions, no less than his searching analysis of the handicaps under which the social scientist at present works, merits the close attention of the scientific worker even at the present time of crisis and strain. Unless we surrender the idea or resolve of victory, we must face now the issues involved in the ordering of a new society in which creative intelligence and human personality find full expression. We must free our social scientists to think with all possible penetration wherever their thinking may lead, and assist the minority of pioneers whose work in the social studies is reaching up to new levels of scientific achievement.

Intense as may be our immediate concern with our war effort, we must still spare thought for the future if that effort is to reap its full reward. We may still attempt the removal of those handicaps on social investigations to which Dr. Fosdick refers —the establishment of a sound balance between the extension and the transmission of knowledge in this field, the extent and manner of endowment of social research, the training of the social scientist on broader lines, and the establishment of effective relations between the social scientist and the world of action which is his laboratory. The solution of the problems confronting society is the task of all its intellectual and moral agencies. Society may, however, fairly expect of the social scientist that as part of his contribution to our war effort he should be objective and technically competent, and deepen and make more definite our understanding of fact and relationship in the social world.

Nor are these words for the social scientist alone. It is well to be reminded in this fateful hour of the supreme values for which we contend, the importance of creative thought and of the free expression of human personality. We may well be grateful that there are those of our race across the Atlantic who see so clearly as Dr. Fosdick the real issues before us, and can define the task with a lucidity and precision which at least hint at comradeship in its discharge.

PRACTICAL SCIENCE IN SCHOOLS

THE publication of a communication from Mr. A. G. Lowndes, formerly biology master at Marlborough College, on page 863 of this issue raises a problem which has for long exercised heads of schools and administrators: the problem is whether the money spent on science laboratories and their equipment is justified by the results achieved, especially in the teaching of biological science. Essentially this problem resolves itself into two parts: first, what is the aim of science teaching, and secondly, how may this aim be best achieved?

The aims of science teaching have been well stated in the Spens Report; to give pupils some knowledge of natural laws and of their application; "to reveal the influence of scientific thought and achievement in the evolution of our present day civilization"—an appeal to social interest and social utility; and to give an introduction to scientific methods of thought and investigation. There can be little disagreement among science teachers on these aims; they are, indeed, those which have been held to be valid for so long as science has been a subject in school curricula. There is, however, some disagreement on how they may be achieved; for it has in the past been widely held that practical laboratory work is essential. Impetus to this view was given by Prof. H. E. Armstrong, whose influence on the teaching of science at the end of the last century was profound, and who insisted that pupils must be placed in the attitude of discoverers, and must, therefore, be given opportunities for discovering, in the form of a laboratory and apparatus. Sir Percy Nunn has expressed this view thus: "to make our pupils feel, so far as they may, what it is to be, so to speak, inside the skin of the man of science, looking out through his eyes as well as using his tools, experiencing not only something of his labours, but also something of his sense of joyous intellectual activity". In its official publications, the Board of Education has frequently stressed the importance of practical work in science, but has invariably qualified this by pointing out that other methods of presentation are complementary.

There is considerable difference between the practical work possible in physical science and that in biological science. The metrical aspect of physical science (as taught in schools) makes laboratory work comparatively easy to arrange and organize with large classes, and there is a wealth of experiments which can be completed in the space of a double school period. In biological science much more time has usually been spent on observation and laboratory technique (notably dissection and section cutting), and much of the experimental work occupies days and even weeks before conclusions can be reached. There are, however, physiological experiments which can be carried out without taking up excessive time, for example, on plant and animal tropisms and on bacterial cultures.

The attempt to get pupils "inside the skin of the man of science" by means of practical laboratory work cannot be said to have been wholly successful. Dr. Michael West (*Educational India*, 6, No. 4; 1939) has stated that "it is perfectly possible for these expensively educated children to pass right through a school science course and remain at least fifty years out of date in scientific knowledge, to be ignorant indeed of all that really matters in the science of to-day". Much the same view is expressed by Prof. J. D. Bernal, in "The Social Function of Science", in a reference to the report of the Science Masters' Association on the teaching of general science: "Only in the last year year does the outlook become modern, but even then nothing later than 1890 is introduced"; and, "The chemistry is worse; the whole course contains nothing not known in 1810." Bernal also stresses that nearly all practical work in schools is "either preparation, measurement, or description, all operations essential to science but by themselves entirely insufficient".

There is evidence from American research that factual knowledge and knowledge of scientific method can be imparted as successfully by demonstration as by practical work, and demonstration certainly has the advantage of being less expensive, in time and money, and of setting a standard of work which is not achieved when pupils themselves carry out experimental work. Nor need demonstration be didactic, for every learner is encouraged by the skilful teacher to play a part, by suggestions and observations, in the demonstration as it proceeds. In this connexion the Spens Report mentions that "by a greater use o good demonstration we believe that scienc teachers will more commonly stimulate wonde and imagination".

That the place of practical work in the biology syllabus is being subjected to increasing criticism is borne out by the fact that recently a strong representation from the teaching profession ha suggested to certain examining bodies that th amount of practical work in the syllabus shoul be considerably diminished, and that failure i practical work at the examination should no longe involve failure in the biology examination as a whole.

It is not suggested that all practical work should be jettisoned, but rather that the warning issued in 1933 by the Board of Education in "Science in Senior Schools" should be heeded: "Many schools are in danger of falling into superstition and treating practical work as a ritual." A new stimulus to real scientific investigation, involving purposeful practical work, has come from the development of rural activities in an increasing number of schools, particularly public elementary schools. Wherever a garden is maintained, and wherever live-stock is kept (poultry and pigs are popular), real problems capable of scientific solution by pupils at once crop up. How to obtain the maximum yield from a soil as yet unanalysed; how to feed a pig in order to obtain the maximum weight at a certain age; how to house hens so that they are healthy; these and kindred problems involve observation, measurement, recording and, most important, *planning* and the proper use of controls. (At least one influential university teacher has stated that his scholarship pupils seem often unable to *plan* their experimental work.) The problems arising out of rural activities are susceptible to laboratory treatment, though the laboratory may sometimes be out of doors; they are real first-hand problems, with educational, social and utilitarian values, which cannot equally be said to be true of the routine experiments so frequently carried out in school laboratories.

A final point to bear in mind, especially during present circumstances, is the difficulty in obtaining material (especially biological) for laboratory examination and experimentation. This difficulty has always been present and never satisfactorily solved. Now is the time, therefore, to tackle this problem, not as a temporary measure, but with the view of eliminating the necessity of at any rate certain kinds of material altogether.

THE STONE AGE OF MOUNT CARMEL

The Stone Age of Mount Carmel
The Fossil Human Remains from the Levalloiso-Mousterian. Vol. 2. By Theodore D. McCown and Sir Arthur Keith. Pp. xxiv + 390 + 28 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 63*s.* net.

THE human remains described in this very important and voluminous work come from two neighbouring caves—the biggest, et-Tabūn (Levels B and C), and the other a mere rock shelter, Mugharet es-Skhūl (Level B). The first, a big cave, is at the mouth of the Wady Mughara, looking down on the coastal plain. The second is a little above the foot of the valley, slightly upstream and on the same bank as the first.

The excavations, carried out jointly by the British School of Archæology in Jerusalem and the American School of Prehistoric Research, were directed during six years work (1929–35) by Miss D. Garrod, with various fellow-workers, Mr. Theodore McCown taking her place during one year when her health obliged her to rest. It was during this year that the greater part of the site of es-Skhūl was examined (continuing the work previously begun) and that, in a breccia as hard as building stone, most of the graves were discovered.

Et-Tabūn was excavated by Miss Garrod on her return, while Mr. McCown, with the help of Sir Arthur Keith and of the staff of the Royal College of Surgeons of England, devoted himself to the very laborious task of freeing, preparing, restoring and studying the very important remains from es-Skhūl. This work began in 1933 and finished with the publication of the present big volume; not too large, since the remains of Quaternary man studied were adults as well as children of both sexes: three almost complete skeletons with their skulls in a good state of preservation; five less complete with their skulls crushed, a single leg and sixteen other fragments from Skhūl. Tabūn produced only one complete skeleton, a mandible and other isolated fragments. The approximate ages of these individuals are given as four, five and ten years, five people between thirty and forty, and one of about fifty.

Although, except for some slight remains in a final Acheulean level at Tabūn, all the rest of the human remains are associated with a Levalloiso-Mousterian industry, they are not exactly contemporaneous. Those at Skhūl came with a fauna in which bovine animals predominated, and those of Tabūn with one in which the gazelle was most common. But these differences are not far apart in time, so that these funerary remains can be considered as almost contemporary.

Very different characteristics distinguish the human types, Tabūn I possessing many Neanderthalian traits, and the men of Skhūl exhibiting all the transitional features leading from the Neanderthal to the Neanthropic Cro-Magnon type.

The authors think that the human type of Mount Carmel was subject to variations greater than those of any living human group; so much so, that, if it were not for the intermediate types seen even in the same level, these variations might be considered as two distinct races, one akin to the Neanderthal and the other to the Cro-Magnon. Having examined the question as to whether it was interbreeding of the two which produced these intermediate types, the authors reject that idea and prefer to consider it as an example of a human group in a crisis of mutation.

These leanings towards a Neanderthalian type produce a strain more resembling that associated with the Central European interglacial Krapina, Ehringsdorf and Steinheim type, rather than the Rhenish or French Neanderthalian. As for the skulls, many are like the Neanthropic group of Předmost, but they have far more Cro-Magnon traits. If, by the forehead, ribs, vertebræ and teeth (though the ribs are flattened as in Neanthropic man) the people of Mount Carmel may be classed, like the Galilee skull which is of the same race, as Neanderthalians, by the height of the man of Skhūl (1 m. 70 cm. and 1 m. 78 cm.), and the characteristics of most of the limbs (not of all, for some are more Neanderthalian), these Palestinians have chiefly Cro-Magnon traits.

This all goes to support the theory of Hrdlička (1927), who held that the Cro-Magnons of Europe descended from the Neanderthalians of the same continent. But, though this may be possible, according to the authors' ideas, it is too simple an explanation, and in any event severe glacial conditions cannot be evoked as the discriminating factor, since in Palestine there were pluvial and not glacial periods. Still, it is true that a transitional human type is found there, leading from one race to another. They are not proto-Cro-Magnons, but proto-Caucasians, their cousins.

The authors then pursue their detailed analytical comparative study in Chapters iii–xxii, treating successively the foot, leg, thigh, pelvis, vertebral column, thorax, shoulder girdle, hand, fore-arm,

arm, dentition, mandible, facial and cranial characteristics of Skhūl V, of Tabūn I, of Skhūl IV, then IX, II, VI, VII, and the brain of Skhūl I as reflected in the endocranial cast.

In a review such as this, one cannot follow the authors in their innumerable comparative tables and measures, and we pass to Chapter xxii, "An Analysis of the Structural Character of the Mount Carmel People", producing twenty-five points of comparison between the Neanderthal, Palestinian, Mount Carmel and Cro-Magnon peoples. This shows that the Palestinian of Mount Carmel has only three points in common with Neanderthal man (frontal torus, shape of the malar, pattern of the teeth): eight points in common with the Cro-Magnon and twelve which are intermediate. Comparing 86 other details of unequal importance, the authors arrive at a total of 111 characteristics examined: 16 are Neanderthalian, 32 Neanthropic, 46 intermediate, 13 indeterminate and 4 special. But if most weight is attached to details concerning the teeth, eyebrow ridges, shape of the cheek-bone, the sphenoid and certain metacarpal bones, and the many intermediate characteristics, the authors think that the Palestinian of Mount Carmel should be classed as genus Palæanthropic, but forming the link with the genus Neanthropic.

AN ANALYSIS OF THE STRUCTURAL CHARACTERS OF NEANDERTHAL, MOUNT CARMEL AND CRO-MAGNON MAN

Neanderthal Man	Mount Carmel Man	Cro-Magnon Man
Stature, short but stocky.	Men tall, women short, or of medium stature.	Men tall, women of medium stature or small.
Head massive with the facial parts large relatively to the brain-containing part.	Head massive, but face not excessively developed.	Head massive but not excessively developed.
Skull dolichocephalic or mesaticephalic.	Most are strongly dolichocephalic; but one Tabūn woman has an index of 77.	Most are strongly dolichocephalic.
The vault is very low (platycephalic).	Vault of medium, or even above, medium height.	Vault high.
Eyebrow ridges assume form of continuous torus.	Torus, but with a tendency to separate into median and lateral parts.	Separation into median and lateral parts is complete.
Forehead very receding.	Forehead moderately full.	Moderately or fully developed.
Occiput *en bourrelet* compressed vertically, does not project behind attachment of neck.	Not compressed vertically. Projects slightly beyond attachment of neck.	Compressed laterally. Projects well behind attachment of neck.
Face—particularly the upper face—very long.	Face of moderate, or above moderate, length.	Face of moderate length.
Face prognathous.	Face usually orthognathous.	Face orthognathus.
Malar bone has the flat form seen in anthropoid apes.	Malar is flat and anthropoid-like, but with a decided tendency in some individuals towards a Neanthropic form.	Malar is Neanthropic.
Superior maxillæ are devoid of canine fossæ and are snout-like in form.	Superior maxillæ, although devoid of fossæ, are flattened in front but not snouted.	Neanthropic.
Orbits are large and rounded in form.	Orbits wide but not high.	Orbits wide but not high.
Nose very large, projecting and wide, its lateral marges not demarcated from face.	Nose variable in projection and width; laterally it is partially demarcated.	Nose variable in projection, usually narrow; laterally sharply demarcated.
Subnasal part of face is deep and wide.	Subnasal area wide, but not deep.	Subnasal area moderate in width and depth.
Mandible robust.	Variable, some robust, others if large yet not robust, some small but stoutly built.	Moderate in development both in size and strength.
Chin absent or rudimentary.	Chin absent, or of moderate development.	Chin moderate or well developed.
Ascending mandibular ramus very wide.	Width varies, in some very wide, others of moderate width.	Width varies, some very wide.
Mandible, in the region of the angle truncated or flattened.	Angle moderately developed.	Angle moderately or well developed.
Teeth are big.	Teeth are moderate in size or large.	Teeth moderate in size.
Molars retain certain primitive characters.	Molars retain certain primitive characters.	Molars are Neanthropic in characterization.
Spinal column and its vertebræ present pithecoid characters.	Spine and vertebræ possess certain Neanderthaloid features; others are Neanthropic.	Spine and vertebræ are Neanthropic.
Adaptation to the upright posture and to bipedal progression less perfect than in Neanthropic man.	Adaptation to bipedal progression apparently as perfect as in modern man; cervical curvature probably less developed than in Neanthropic man.	As in Neanthropic man.
Lower limbs short.	Lower limbs long.	Lower limbs long.
Mean cranial capacity about 1,400 c.c.	Capacity in 3 adult males ranges from 1,518 c.c. to 1,587 c.c.; one woman (Tabūn) 1,271 c.c.; one woman (Skhūl) about 1,300 or 1,350 c.c.	Capacity large.
In form the brain shows primitive or simian features, particularly in the small size of frontal lobes and in convolutionary pattern.	Neither in size nor in form of lobes is there a decided difference from brain of Neanthropic man. Convolutionary pattern, so far as our evidence goes, was simple.	Lobes large and well convoluted.

It is still an open question whether the woman found in Tabūn I, who is the most Neanderthalian of all those found, represents a different race, and what is her place in time compared to the people of Skhūl. The few remains found either in the Acheulean or neighbouring overlying levels have certain characteristics which make it difficult for the authors not to class them as older than the people of Skhūl. They consider the Tabūn type older, though this has been contradicted, for on p. 265, where the character of the Tabūn woman's skull is compared with those from Skhūl, we read: "Cranial characters support the view, already founded on a comparison of their skeletons, that they represent different types or breeds of humanity, and yet breeds of the same stock. In the Skhūl cranium there are many Palæanthropic features, but these are overshadowed by those of a Neanthropic character. In the

Tabūn cranium it is the opposite, the Palæoanthropic features vastly preponderate over the Neanthropic." The author of this part of the text remarks on the close relationship between the female skull of Tabūn I and the Neanderthalian skull of Gibraltar, although it differs by certain Neanthropic features such as the angle of the skull's development, a rise in the vault and flattening of the sides of the skull. The conclusion is that "the Tabūn woman represents a separate race of the Neanderthal type, the difference between the Tabūn and Gibraltar skulls being of approximately the same amount as that which distinguished the skull of a European from that of a negro".

We quote the summing up: "We find it very difficult to believe that these are mere individual anomalies; they have all the appearance of intrinsic structures of morphological value. Only future discoveries can resolve the problem of her position—whether an individual sport, or a representative of a distinct race."

As I heard Prof. Boule say, speaking of the Palestinian man: "The complexity of evolution amongst human types, as new discoveries are made, and this one in particular, far from simplifying the problem, appears little by little to present us with new ones, still insoluble".

I would add that, in spite of the enormous progress and the sensational discoveries which have been made in modern times, such as those in Palestine, Chou-Kou-Tien and Java, Palæanthropic anthropology is still necessarily 'in the making'. It cannot be otherwise, for we must remember that, though we are fairly well informed about the human types contemporary with the last interglaciation, and later times, we know extraordinarily little of what took place during the two preceding interglacial epochs and the intervening glaciations, though these represent more than sixty per cent of the time that man has existed.

In spite of everything, a certain law of gradual development becomes more apparent each time, and however much we hesitate over such problems, they grow clearer each day, showing us human types less and less removed from anthropoids.

H. BREUIL.

EVOLUTION AND FATS

The Chemical Constitution of Natural Fats
By Prof. T. P. Hilditch. Pp. xi+438. (London: Chapman and Hall, Ltd., 1940.) 35s. net.

THE fats constitute a large group of natural substances. They are present in plants and animals on land and water, both salt and fresh; they represent an important ingredient of our food. To the chemist they are compounds of glycerol with fatty acids, long straight-chain carbon compounds in an ascending series of numbers from C_{14} to C_{24}, increasing by two carbons at a time. Nature has curious devices, eccentric habits; one of them is to ring the changes with relatively few substances, combined together in different ways, so as to produce a vast number of different fats, that is glycerides, characteristic of individual plants and animals. The process is akin to the infinite number of melodies which the pianist can produce on a few notes.

The devices of Nature have to be discovered in the laboratory; they cannot be reasoned out in a dark room until sufficient data have been accumulated to justify the setting up of a theory, which is only then of value when it leads to new experiments. The nature of animal fats was first established by Chevreul in classic researches published in 1823; it is noted that he was a determined enemy of charlatanism in every form. Since then, research on the fats has gone on in laboratories throughout the world, and the accumulated knowledge provides material for many volumes. Nowhere has the search been more diligent or more successful than in the laboratories at Liverpool under the leadership of Prof. T. P. Hilditch. He has devised new experimental technique of much higher accuracy, and accumulated data as to the nature of some six hundred natural fats.

Valuable as is such work in itself, it acquires new interest when chemical structure can be related to biological source. The monograph before us is written with this intent. Science proceeds on the assumption that the world is intelligible, and we may claim that it is an achievement to establish a relationship, a sequence, between the nature of the fatty acids present in fats and the biological development of their parent organisms.

The connexion was developed in outline in NATURE in 1936 (**137**, 479) in an article by Hilditch and Lovern, but it is of sufficient importance to give it a paragraph. The most widespread of natural fats is oleic acid; the major saturated acid is palmitic acid with sixteen carbon atoms. In freshwater life, C_{16} and C_{18} acids predominate, but in salt water there is both greater unsaturation and a high proportion of acids up to C_{24}—nearly 30 per cent in marine fish.

Coming on land, there is a simplification in the number of fatty acids, there being a definite gradation through the amphibians, reptiles and birds to the domestic animals, which is largely in parallel with the course of evolution traced by the biologist. It is to be expected that a change in external character indicates a change in chemical architecture, but it could not so easily be predicted that the change in the fats would parallel evolution,

It is a triumph for the learned doctors of chemistry,

"Profoundly skilled in analytic,
Who can distinguish and divide
A hair 'twixt south and south-west side."

Plant fats, as has long been known, sometimes contain as major constituents a specific unusual fatty acid confined to one or at the most only a few of the natural plant families: plants seem to have the urge to be enterprising and try chemical syntheses on their own. Another fact relating to plant fats is the relation between saturation of the acid and climatic temperature: in cooler climes linseed oil is as a rule more unsaturated.

The monograph is arranged so as to bring into prominence the component acids of fats. It contains chapters on the component glycerides, on the chemistry of the acids and on experimental technique. It is a storehouse of knowledge, a guide to future experimentation and a stimulus to the reader. A philosopher condemns science because it enthrones the measuring, weighing, calculating faculty of the human creature. The achievement described here may be set against such criticism. E. F. ARMSTRONG.

BOILER WATER TREATMENT

Boiler Feed Water Treatment

By F. J. Matthews. Second edition, revised and enlarged. Pp. 319+16 plates. (London: Hutchinson's Scientific and Technical Publications, 1939). 12*s*. 6*d*. net.

WHEN this book was originally published in 1936, it was pointed out by the author that while the great developments which had recently been made in the methods and apparatus for boiler feed water treatment had been very advantageous for those in charge of the larger steam plants, they had created a problem for the small operator who has not at his back all the facilities which exist at the big power stations, but is forced to worry out his problems for himself. In relation to feed water treatment, the problem is to know what is the right thing to do in a given case, for, without clearly stated principles and well-substantiated practical guidance, it is difficult for the average technician to exercise a fair judgment as to the appropriate system, and to ascertain if all goes well when his choice of plant has been installed.

Generally speaking, three courses are open to the boiler operator: the use of one of the proprietary softening agents, the installation of a lime-soda plant, or the adoption of the zeolite or base-exchange system. The purpose of this book, therefore, was to provide such practical information as would place him in a position to be able to choose and operate a water-softening plant with intelligence and efficiency. The author deals with the subject in a logical sequence which will greatly appeal to the practical man as well as to the student and chemist. He describes the various types of natural waters, and explains in what respects they prove unsuitable for use as boiler feed. Proceeding then to operating troubles, he gives first the older corrective measures and then, by setting out their failings and insufficiency, brings into their proper perspective the later improvements which have been effected. Four main aspects of water treatment and its bearing on boiler operation are dealt with, these being scale formation, corrosion, foaming and priming, and finally analysis and routine testing. From this method of presentation there emerges for the reader a clear picture of the purposes served by each process or combination of processes.

In this enlarged edition a considerable amount of revision is apparent, bringing the information up to date and in line with the results of recent research. Caustic embrittlement, one of the most serious problems of the boiler-house engineer in recent years, is treated in considerable detail, and the numerous contributory causes, preventable and unavoidable, are set forth. Among other new features are the subjects of colloidal conditioning, the Budenheim process, electrical scale prevention and the avoidance of turbine deposits. For students, the selected references at the end should also prove a valuable addition.

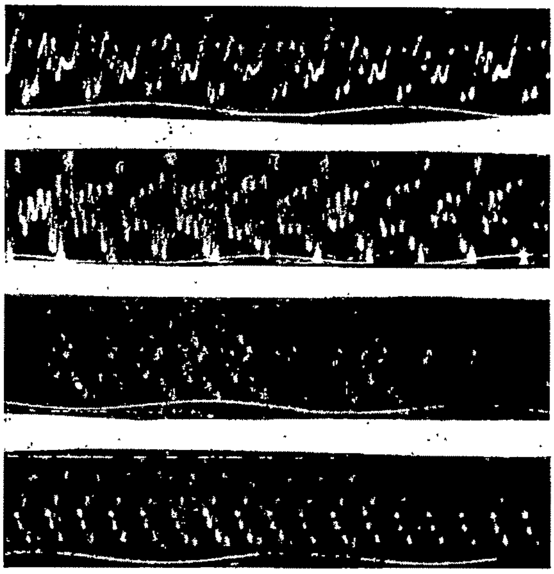
RECENT WORK IN EXPERIMENTAL PHONETICS

By Dr. E. G. Richardson,
King's College, Newcastle-on-Tyne

It is now ninety years since Scott with his phonautograph—the precursor of the gramophone—first made traces of the wave forms of speech sounds. The mechanical wave-tracers progressed and reached their peak of development in the phonodeik of Miller, but they have been largely superseded by electrical recorders. The talking film and the cathode ray oscillograph have found their way into the phonetics laboratory, and the physicist has been called in to assist the philologist in the scientific study of speech forms. Such a team of workers operating an experimental phonetics laboratory (such as that of King's College, Newcastle-on-Tyne[1]) can carry out useful work in the classification not merely of standard English speech forms, but also of local variants, which may be preserved in the form of gramophone or film records to remain, perhaps as museum pieces, when all speech has been reduced by education and broadcasting to a dull uniform 'standard English'. To this end a number of linguists are exploring the country districts of Great Britain, where special forms die hard, with portable recording equipment, to persuade the older people to "say something into the microphone".

Any points which require detailed examination may be pursued further in the laboratory, where by means of electrical pick-ups or photo-electric cells the wave-form characteristic of a vowel or consonant may be selected and projected on to the screen of the cathode ray oscillograph. By such means, for example, it is possible to distinguish the Northumbrian 'burr' or guttural *r* from the frontal *r* which the French adopt, even when it occurs in rapid speech so that the distinction might fail to be detected by a sensitive ear.

Such deductions cannot be made without certain safeguards, and it is here that the co-operation between scientist and linguist is most helpful. On one hand, the philologist is apt to be mazed by the elaborate convolutions in the wave-form of a simple vowel—and even to the physicist, it seems a big step from the wave-form of a tuning-fork to that of a vowel; on the other hand, the scientist, in his desire to attach a label to every sound, is liable to read into the record sounds which are not there. For example, a record has been published of the wave-form of the word *farmers* with a section ascribed to the central *r*, which is never pronounced in normal English speech.



Wave-forms of the vowel ɑ at frequencies of 104, 129, 150 and 208 c./sec. respectively. (Photo by W. Riddell.)

Amid a vast accumulation of such records, it is pertinent to inquire how much can be learned from speech wave-forms. How far can the sound ɑ be recognized as such, when uttered by different persons or by the same person in different circumstances? The difficulty is enhanced when one reflects that vowel sounds are not quantized, but range over an infinite number of fine gradations; so that how many distinct vowels should be recognized and where their boundaries lie are matters hotly contested by the philologists themselves. The problem is being tackled in the King's College laboratory by making collections of oscillograph records of the same vowel enunciated at a series of pitch values.

A set of such records of the vowel ɑ by a male voice is reproduced herewith. The characteristic pattern of this vowel—a series of peaks diminishing in height within the period—can be recognized in each trace, although analysis of each trace into its acoustic spectrum scarcely helps the identification. It reveals not only a change in the fundamental pitch but also, accompanying each fresh setting of the vocal cords, the intrusion of sufficient harmonics of the fundamental to disguise in the spectrum the fact that the same vowel is being enunciated throughout the set.

Changes in the spectrum also occur when the intensity is altered, the pitch remaining constant. The general effect of singing the vowel more loudly is to throw more of the energy into the higher partials. This is what might be expected of any form of musical instrument. It is shown, for example, in the timbre of the clarinet played at a fixed note with rising blowing pressure.

Of course, one must not overlook the psychological aspect of these tests. Someone, either the speaker or a listener, has to judge whether the task set—to enunciate the same vowel at different values of the fundamental pitch or of intensity—has been faithfully carried out. Actually, it is difficult to keep these two changes—of pitch and loudness—separate, the general tendency of a choir being to raise the pitch of a note which it is asked to sing more loudly, particularly if it is unaccompanied by an organ or orchestra. There is, however, more behind this than a mere psychological exhilaration on the part of the singer or speaker. Our vocal apparatus is such that it is physically impossible to sing a given vowel over a wide range of intensity. Certain vowels also having important partial tones low in the musical scale cannot be truly elicited at a high pitch. Female singers especially have to make a compromise with such vowels sung at a high pitch, though the context provided by the neighbouring consonants usually suffices to convey the meaning of the words so altered.

Other variations in the wave-form of a vowel may be introduced by the consonant which precedes or follows it. With the exception of the so-called voiced consonants, these sounds may be likened to those which occur during the attack on, and relinquishing of, a steady note by a musical instrument; such sounds as the biting of the bow upon the violin string and the tonguing of the flute by the player. It has recently been shown by J. W. Black that these transient speech sounds have little influence on the vowel sound which follows or precedes them, during the period that the vowel holds the field. (The same applies to mechanical instruments of music.)

Minor deviations from what one may regard as the standard form of the vowel occur during the sustained singing of it or even within the few seconds which it occupies in conversational speech. The 'tone' of the muscles which put tension upon the vocal cords, the 'blowing pressure' within the lung-bellows, the setting of the mouth resonator; these are not rigidly set in the human instrument as they are, for example, on the organ while a key is held down. It is not surprising, therefore, to find slight fluctuations in the wave-form from one period to the next during the enunciation of one and the same vowel. The strips of film reproduced in the figure would not exactly overlay other strips from the same films ten feet farther on, but such deviations would appear of little significance compared to the variations between the four films shown. Some philologists make much of these variants within the record of a vowel. E. W. Scripture indeed goes so far as to consider that they invalidate any application of Fourier analysis to the wave-forms of vowels.

Nevertheless, there is hope for the view that to each vowel a definite wave-*pattern* may be attached. Moreover, the majority of recent research favours the 'formant' theory of vowel sound production. This regards every musical instrument as being composed of a resonator or system of resonators coupled to an exciting or maintaining agency. In the human voice the exciting element is located in the vocal cords, while the cavities of the mouth, nose and sinuses form the sound-boards. The setting of the exciting agency at a definite fundamental frequency will give rise to a sound, the acoustic spectrum of which will be rich in those resonances which happen to march with the fundamental exciting frequency or its attendant harmonics. This formant of resonances—or 'wolf notes' as the violinist calls them when they are undesirably prominent on his instrument—is an individual characteristic. On most mechanical instruments and, for that matter, in the voices of animals like the cow and the dog, the formant is fixed, but man has learned to change these sound-board resonances by subtle gradations whereby the different vowel sounds may be recognized by an interlocutor.

The existence of a formant proper to each vowel is the cause of such variation of the wave-pattern with pitch as is shown in our figure. Of course, there are certain portions of the vocal resonators which remain unchanged in size and therefore in frequency as the speaker readjusts his cavities for another vowel, and these have been recognized in the acoustic spectrum of most of the sounds uttered by an individual in normal health. They are as characteristic of the adult individual as his finger-prints. The formant theory is supported by the possibility of synthesizing vowel sounds out of models constructed of a generator coupled to variable resonators, as in the well-known work of Sir Richard Paget with mechanical models on one hand, and that of Dr. W. H. Eccles and Prof. G. W. Stewart with electrical models on the other.

Another feature which characterizes speech is intonation—the variation in intensity and pitch which a person puts into a speech. Compare, for example, the level monotone of an Italian announcer in the broadcasting service with the excessive modulation of his Swedish confrère ; or the stolid utterance of the Somerset man with the lilt of the East Anglian or Northumbrian. This is a characteristic which may readily be measured on inexpensive electrical apparatus of the noise meter and beat-frequency types. Both these instruments incorporate some form of valve-voltmeter in their final stages, the deviations of which from a mean setting (of intensity and frequency, respectively) can be recorded as a flickering of the needle, or, better still, as the root mean square value of the deviations. The latter figures can be obtained if some form of wattmeter in the output stage is used, and may be taken as a measure of intonation, in the same way that the root mean square value of the deviation from a standard stream velocity is taken in hydrodynamics as a measure of the intensity of turbulence in the stream.

Nor must the physiologist be left out of this work. Though experiments on the vocal apparatus of dead mammals played a part in the early development of phonetics as an experimental science, results so obtained are rather discounted as criteria for the science of the human voice to-day. Much, however, is to be learnt from X-ray photographs of the larynx taken when set in position for the production of a sound, which is oscillographed at the same instant. Such studies are being made by—among others—Prof. O. Russell in America and Dr. R. Curry in England.

Other work which should prove of great import to linguistic studies involves the taking of high-speed cinematograph pictures of the motion of the vocal cords as seen through the laryngoscope. Such photographs, in various modes of action of the cords, normal, falsetto, etc., are now being obtained in the laboratories of the Bell Telephone Company at New York.

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[1] NATURE, 133, 655 (1934).

PLANNED WHEAT PRODUCTION

BY SIR JOHN RUSSELL, F.R.S.,

ROTHAMSTED EXPERIMENTAL STATION

WE have in Great Britain nothing quite like the Food Research Institute of Stanford University, California, which periodically publishes important monographs on foods, and in consequence it would have been difficult to produce here the comprehensive study "Competition among Grains" recently issued by Dr. Jasny. Mr. Paul de Hevesy's achievement in completing his great work "World Wheat Planning* is therefore all the more remarkable, and he is to be congratulated on having brought together in one volume an enormous mass of data relating to the production of wheat in the different countries of the world, its distribution and its consumption. The labour involved has been prodigious, but it is known that he has been engaged on this work for a long time, and his extensive knowledge of the subject is well recognized.

Wheat, like sugar, affords an example of the triumph of politics over Nature. Both crops grow admirably in the regions naturally suited to them, and these regions are adequate to produce all, and more than all, that the world is likely to require. If they were in fact called on to produce all the supplies, the necessary corollary would be unhampered trade between the producing and the consuming countries. But there is an alternative method. Science has opened up the possibility of growing both crops in conditions not naturally suited to them, and so enabled many countries to produce their own supplies. It is true that the supplies cost more, are less certain and less abundant than by the other method, but in those countries where political considerations have dictated a policy of autarky or self-sufficiency, agricultural science is called upon to make the best of the task of growing a crop in conditions not really suited to it. Two general methods are adopted : the environmental conditions are changed by various devices of soil management, and the plant is changed by cross-breeding and other methods. Sooner or later pathological problems arise, sometimes of great importance : these also have to be dealt with.

Wheat is really a plant of the semi-arid regions : it has been found wild in Asia Minor, northern India, Abyssinia, etc. Throughout long years of cultivation many varieties have been selected or bred, but the crop still retains its semi-arid nature.

The optimum climatic conditions for wheat production are a moderately low rainfall of about 20–25 inches per annum, with dry warm weather for maturation and harvesting. These conditions prevail over great belts of continental areas, especially in North America, Australia, and Eastern and Central Europe, including the U.S.S.R.; in these regions wheat can be grown cheaply and in abundance. England, with its many soils and climates, also has a considerable proportion of wheat-growing regions. The area east of a line from Durham to the Isle of Wight is largely suitable, and another area extends westwards from the southern part of this line; the boundary is roughly the escarpment formed by the Inferior Oolite outcrop. The determining factor is chiefly the rainfall but with soil as a strong subsidiary, for wheat is less easy to grow than grass on a heavy clay soil or than barley on a light one, so that it tends to keep to the loams. It is better suited to heavy than to light soils, and in the old days was much grown on the clays in the eastern counties, the Midlands and the south; for this purpose the land was laid up in high ridges separated by deep furrows, many of which still remain, giving a curious wave-like appearance to the pastures. Their original purpose was to provide drainage, and although modern mole-draining would be much better, the cost of levelling the ground would be more than the land was worth.

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* World Wheat Planning and Economic Planning in General. By Paul de Hevesy. Pp. xv+912. (London : Oxford University Press, 1940.) 38s. net.

The area under wheat in Great Britain was at a maximum in the early 1870's, when there were 3½ million acres. The total production was probably about 2½ million tons, sufficient for the needs of 19 million people at present rates of consumption (300 lb. wheat per head per annum). The population of Great Britain in 1871 was 26 millions, so that the home production amounted to 73 per cent of the total consumption.

Even in those days there were importations of wheat from America, Australia and Europe, but only by way of completing the home supplies. Then, with almost dramatic suddenness, wheat growing in England become unprofitable. The American and Canadian farmers had been rapidly breaking up the prairies, the railway was pushed across the continent and the trans-Atlantic steamship services were organized. When the chain was completed, wheat was brought over from North America in great quantities and sold on our markets at prices far below the cost of production here and, in some years during the financial crises in the West, below the cost of production there. The politicians of the day decided to leave economic forces alone and so did nothing; English farmers gave up wheat-growing, and a short time before the War we were producing not much more than 10 per cent of our total consumption. Then the Government stepped in, and virtually made a contract with farmers to produce about 15 per cent of home requirements at an agreed price. The actual arrangements were complicated by the fact that the Government did not wish to interfere with the usual marketing arrangements, and so left the ordinary machinery at work, but paid to the farmers the difference between the market price which they had actually received and the contract price which they were due to receive. These are called 'deficiency payments'; they work well enough so far as the farmer is concerned. Unfortunately a section of the Press calls it a "subsidy", which, of course, it is not. Most business enterprises nowadays are worked on contracts, and it would be a very good thing if the system were more widely extended to agriculture.

As a result of the Wheat Quota Act, the nation can count on 15 per cent of its requirements being met at home, and in peace-time this proportion is fairly satisfactory, though a case could be made for a larger one; however, the figure is a good compromise. For there is a very considerable difference between ordinary English and imported wheat: the English wheat does not give the large, well-piled loaf obtainable with the so-called 'strong' imported wheat, and the English housewife, therefore, does not like it and will not buy it. Most of the mills are situated at the ports, and they use in normal times only a small fraction of English wheat: the inland mills use more, especially when they can get the one 'strong' wheat commonly grown in England—Yeoman, produced by Sir Rowland Biffen at Cambridge. English wheat is much used for biscuit-making and for poultry feeding; for both purposes it is admirable. What English wheat lacks in 'strength', however, it more than makes up in power of growth, and the English 'weak' wheats include some of the heaviest yielders known. 'Strength' refers only to the character of the dough, and has nothing to do with vigour of growth of the plant or nutritive value of the grain.

In war conditions, a production of only 15 per cent at home is insufficient, and efforts are therefore made to increase the output here. The chief difficulty is that wheat is one of the less productive crops: it usually gives less than 1 ton per acre of dry matter for human food, while potatoes yield two to three tons of dry matter and mangolds may give double this quantity—this, however, is food for animals. The war-time increase comes from the ploughing up of the less productive grass land, our great national reserve of fertility.

An important reason for relying on importation in peace-time is that wheat is one of the easiest of all crops for the farmers on great continental plains to grow. Their first methods led to severe soil erosion, but where this has not gone too far the modern methods are free from this objection. Wheat is also one of the easiest of all agricultural products to store, to transport, and to sell. In a world permanently at peace, densely populated countries like Great Britain could confine themselves to crops giving larger quantities of dry matter per acre, or to products like vegetables, milk, eggs, high-quality meat and fruit where freshness is an asset.

A cynic looking for examples of human folly could find none better than the human treatment of the bountiful supplies of wheat of the last fifteen years. The nations pray that their daily bread may be given to them, and it has been, with a margin to spare. Mr. Hevesy gives a completely dispassionate and objective statement of the results. During the period 1926–34, the world produced more wheat than it consumed : the margin was only small, and never exceeded 2·5 per cent except in one year, but the continued small over-production made the markets so sensitive that prices fell to ruinous levels. Since most of the world's population is engaged in agriculture this loss of purchasing power by farmers and farm workers led to serious industrial and financial depression. The over-production did not arise from heavy yields, but from an extension of acreage partly in Europe as a consequence of the self-sufficiency policy.

Countries that lived in part on their wheat exports—Canada, Australia, the Argentine—had to subsidize their farmers to save them from bankruptcy, while countries that aimed at self-sufficiency found themselves obliged to export temporary surpluses at shipwreck prices, paying the normal price, however, to their producers. Mr. de Hevesy instances a country where 25 million quintals (92 million bushels) excess were produced at an average cost of 19 gold francs (that is, the Swiss franc before its devaluation in September 1936) per quintal which had to be exported at 6–7 francs, the difference being made up by the taxpayer. Yet the small percentage excess that was causing all the trouble was not really superfluous : millions of people in Europe and other countries were under-nourished, but the attempts made at Geneva and elsewhere to persuade nations to buy more bread-and-butter failed.

The trouble was intensified by fiscal arrangements. An inquiry showed that during 1929–30 consumers paid 66,000 million gold francs for their bread, but the growers received only 36 per cent of this total; most of the remaining 64 per cent went in taxes.

There were considerable indications of a further wheat crisis ahead had not the War brought on a still greater crisis. The "Big Four"—the United States, Canada, Argentine and Australia—were last August discussing the possibility of arranging for quotas, and after agreement they intended to hold a wheat conference in London to be attended by the U.S.S.R. and the Danubian countries. The War stopped this, but Mr. Hevesy thinks more wheat crises, with all their attendant evils, are inevitable until world wheat production is planned and organized.

Much of the book is occupied with a full description of wheat production in all countries from which any information can be obtained. In a particularly interesting section on Germany it is pointed out that, prior to the War, Germany was one of the foremost wheat-importing countries, but during the period 1931–35 she became nearly self-sufficient and can now, if the harvest is good, produce all her requirements of wheat, rye and other grains. Nevertheless Germany bought some 15½ million bushels of wheat from wheat-exporting countries during the autumn of 1938, and her reserves must now be considerable. The yield of wheat in Germany between 1890 and 1930 increased by about 11 bushels per acre and is now about 32–33 bushels per acre, about as much as our own yield. Gigantic distributing machinery has been set up called *Reichsnährstand*, a kind of cartel including all farmers and their associations, all merchants of agricultural produce, the exchanges and all processing industries. It is organized like the National Socialist Party itself, having in the village its "confidential agents", above these the district leaders, and at the top the chief for the whole Reich ; practically all the officials are members of the Party. It exercises very complete control over farmers, salesmen, millers and all others who handle food production. The farming is based on the Hereditary Farm Law of 1933, setting up about 700,000 hereditary farms which may be inherited by one child only, usually the eldest, who has no power to subdivide, sell, or mortgage the land without a State permit, and if this is granted at all it is only for sale to another farmer.

While the fixing of prices is effectively carried out, there is no such planning of production as in the U.S.S.R. ; it is left to the individual to decide what he shall sow, and this seems to be all that is at his discretion. The Government, of course, influences his decision by the prices they fix. In the end food prices are considerably higher than in England and the standard of living of the people is lower.

In the section on the U.S.S.R., Mr. Hevesy finds no evidence of increased yields since the pre-Revolution days, notwithstanding enthusiastic claims as to what Russian science has done for agriculture ; also he states that the cost of production, so far as can be ascertained, is very high, in spite of the much-praised mechanization and social-economic system. The total production of wheat seems not to have kept pace with the growth of population. However, Russian wheat statistics are complicated by the change which took place in 1933; prior to that date they were based on the grain actually collected; after that date they are based on the "biological" or unharvested crop, a deduction being made for "technically inevitable losses in harvesting". In 1933 the deduction was given as 10 per cent, that is, about 1 bushel per acre, but much doubt has been expressed as to whether the losses could be kept as low; the figures for production are taken by Dr. Schiller as maximum figures which certainly have not been exceeded.

THE HYDROGEN BOND

By Dr. C. E. H. Bawn,
University of Bristol

It has been recognized for many years that under certain conditions a hydrogen atom can form a connecting link between two other atoms. It may be considered as forming a bond between them, known as the hydrogen bond. Although the hydrogen bond is not strong, recent investigations have shown it to be of very wide occurrence. The concept has been extremely useful in explaining the association of polar liquids like water, the association of carboxylic acids, alcohols, amides, etc., the closure of rings within the molecule, and in interpreting many measurements of structure by X-ray and electron diffraction methods and of the frequency shifts of the infra-red absorption bands of certain known groupings. It was investigations of this type that not only established the existence of this form of bond but also provided information regarding the conditions in which its formation is to be expected, and, in many cases, of the actual energy of the bond. In spite of the enormous amount of experimental data now available, there is still much information which is lacking; the exact mechanism of the bonding power of the hydrogen is not clear, and there are many difficulties with questions of terminology.

With the object of clarifying the situation, a general discussion on "The Hydrogen Bond" was held by the Faraday Society on May 17 at the Imperial College of Science and Technology, London. A number of subjects was discussed in the six papers presented to the meeting, but briefly, the discussion can be considered under two headings: (1) the methods of studying hydrogen bonds by infra-red absorption, X-ray diffraction, and magnetic susceptibility measurements, and a survey of the results obtained; and (2) the occurrence of hydrogen bonds in molecules of biological importance, such as the proteins and carbohydrates.

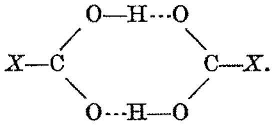
It follows from the quantum-mechanical theories of valency that hydrogen cannot form more than one covalent bond and that the attraction of two atoms as found in hydrogen bond formation must be due to ionic forces. The positive hydrogen ion with no electronic shell around it attracts one anion to its normal internuclear separation, and this could then attract a second anion, namely, $X^-H^+Y^-$. As might be expected, the strength of the bond formed should increase with increase in the effective negative charge of the bonded atoms. Thus fluorine, oxygen, nitrogen, and chlorine should form hydrogen bonds of strength decreasing in this order. Perhaps the best example of this type of ionic bonding is the HF_2^- ion; Pauling considers that this ion resonates among three structures:

$$\mathrm{F\ H\ F^-} \qquad (A)$$
$$\mathrm{F^-H^+F^-} \qquad (B)$$
$$\mathrm{F^-H\ F} \qquad (C)$$

When we come to consider more complex structures involving intermolecular hydrogen bonds, steric requirements must also be satisfied, that is, the interacting groups must be capable of sufficiently close approach to enable the attractive forces to come into play. When we review the conditions of formation of the hydrogen bond, it is not at all surprising that one meets examples of bonds covering a wide range of interaction, from strong bonds to weak bonds, finally emerging into groups of interaction which we know as due to van der Waals forces. It seems at present that the only means of characterizing the hydrogen bond in the molecule is the energy required to break it.

The most important and useful method for the discovery of hydrogen bonding is infra-red spectroscopy. The main results obtained up to the present time were discussed by Dr. G. B. B. M. Sutherland. Every molecule containing an *X*H group gives rise to well-marked absorption bands in the near infra-red, which are characteristic of the stretching and contraction of the *X*H bond.

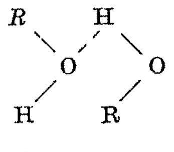
If the hydrogen atom of the *X*H group becomes subject to the influence of a force other than that which binds it to the *X* atom, then the frequency of vibration will be altered and the characteristic band will be shifted. The presence of hydrogen bonds in the molecule can therefore be inferred from the perturbation it produces in the normal *X*H bond. In this way both intermolecular and intramolecular bonds have been determined. As an illustration of the method we may select one of the best-known examples of the hydrogen bond, namely, the dimeric form of the carboxylic acids,



The effect of association is shown by the shift of the OH fundamental frequency at 2·83 μ to 3·25 μ in the acid, and the change in intensity of the band with temperature can be used as a measure of the degree of dissociation of the dimeric molecule, and hence of the heat of dissociation. The method is equally applicable for the study of hydrogen bonds in solids, solutions and liquids. Thus, the association of the alcohols in carbon tetrachloride is characterized by a band at 2·84 μ–2·88 μ, in contrast to the sharp monomeric band at 2·75 μ. Dr. J. J. Fox and Dr. A. E. Martin find that the monomeric O–H bond of benzyl alcohol in carbon tetrachloride has two components, 2·750 μ and 2·765 μ, which seems to indicate two molecular species of the alcohol. At low concentrations this alcohol dimerizes (2·865 μ) and an equilibrium

$$2C_6H_5CH_2OH \rightleftharpoons (C_6H_5CH_2OH)_2$$

is set up, but it is not possible to decide whether the dimer has the structure,



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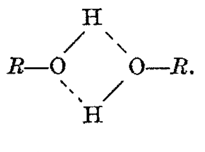
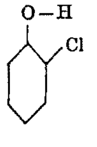


At higher concentrations polymeric association becomes predominant, and this they conclude is in accordance with an equilibrium between dimer and quadruple molecule.

Numerous infra-red investigations have shown the presence of intramolecular hydrogen bonds. The classic example of this group is the two forms of *o*-chlor-phenol,



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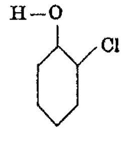
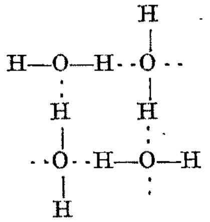
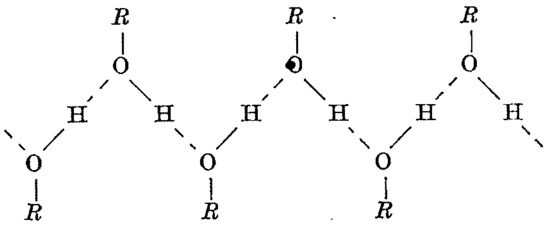


the possibility of *cis-trans* isomerism giving rise to two absorption peaks, one at about 7,050 cm.$^{-1}$ (*trans-* form) and the other at about 6,890 cm.$^{-1}$ (*cis-* form). Many other examples were given in Fox and Martin's paper.

The results obtained by the other powerful method of studying hydrogen bonds was reviewed in a paper by Dr. J. M. Robertson. By this method the distance between the bridged atom or groups forming the hydrogen bond can be directly measured. In this way the presence of hydrogen bonds has been demonstrated in many inorganic and organic structures. Perhaps the most interesting example is that of ice, in which each oxygen is surrounded tetrahedrally by four other oxygen atoms at a distance of 2·76 A. The structure is pictured to be of the type



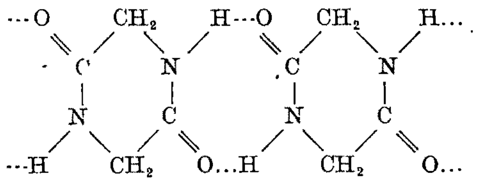
In the crystalline alcohols a similar sort of structure exists, the molecules combining through hydrogen bonds to form indefinitely large structures,



Bernal has suggested that on the basis of results obtained by X-ray analysis, two types of bonds should be distinguished, for which he proposes the names hydrogen and hydroxyl bonds. In the former, hydrogen is attached by equal firmness to two oxygens, O- - -H- - -O, the energy being about 8,000 cal. and the distance between the oxygens being 2·5–2·65 A. In the latter, the hydrogen remains unsymmetrically attached to one of the oxygens, O- - -H—O, giving a bond energy of 5,000 cal. and an oxygen–oxygen distance of 2·7–2·9 A. Since the experimental evidence seems to indicate an almost continuous transition between these two extremes, the necessity for this distinction is not accepted by all.

In a short paper Dr. W. Rogie Angus and W. K. Hill described some preliminary results on a general investigation of diamagnetism and hydrogen bonding. There seems to be every indication that hydrogen bonding should be detectable by susceptibility measurements.

The hydrogen bond may be of great importance biologically, and two papers of the discussion were concerned with the role of hydrogen in determining the structure of the proteins and starch. Our knowledge of the detailed structure of these molecules is still far from complete, and consequently it was not possible to do more than to survey the possible part which hydrogen bonds might take in determining the structure of these substances. In this short summary, one can only restate the conclusion reached by Dr. W. T. Astbury after a critical discussion of the way in which hydrogen bonds may intervene in protein structures, "that whichever way we turn it is impossible to reach a verdict that is really satisfying". However, X-ray analysis of crystalline diketo-piperazine, a substance related to the proteins, shows that the molecules are linked together by hydrogen bonds between their respective oxygen atoms and $=NH$ groups, to form flat continuous chains throughout the structure.



It may be expected that the formation of hydrogen bonds may be important in determining the behaviour of complex molecules containing multiple active hydrogen bond-forming groups, for example, polysaccharides. A critical consideration of this possibility for starch by Prof. E. L. Hirst, Dr. G. T. Young and the present writer shows that the properties of this molecule are inconsistent with those of a structure held together by hydrogen bonds. Analysis of physico-chemical data indicates that the repeating units in starch are held together by normal glucosidic linkages. It is pointed out, however, that the macro-molecules may be associated by hydrogen bonds in native starch.

OBITUARIES

Dr. A. C. Haddon, F.R.S.

On April 10 there passed away in his eighty-fifth year Dr. Alfred Cort Haddon, the doyen of British anthropologists*. Haddon came of Northamptonshire stock, his grandfather founding the firm of John Haddon and Co., printers and typefounders and also produce brokers. The family business connexion brought people from all parts of the world to Haddon's home, and this may well have influenced his choice of a career. From his mother, who wrote children's books, came an interest in natural history, and young Haddon spent much of his time at the Zoo studying and drawing animals. This led friends to advise his father to send him to Cambridge to study zoology, but the boy was destined for his father's business, which he entered on leaving Mill Hill School.

According to Haddon's own account, it took his father scarcely two years to discover that it might be less costly to send his son to Cambridge than to retain him in the firm. So to Cambridge he went, entering Christ's College at the age of twenty, where he worked at zoology under F. M. Balfour and also came under the influence of Michael Foster. It was the former who inspired his first big book, the "Introduction to Embryology" (1887). He took his B.A. in 1879, and was appointed demonstrator in comparative anatomy almost immediately, holding this post until 1880, when he migrated to Dublin as professor of zoology in the Royal College of Science. The M.A. followed in 1882 and the Sc.D. in 1897; he was a fellow of Christ's from 1901 onwards. In 1881 he married Fanny Elizabeth Rose, the sister of his college friend J. Holland Rose (later Harmsworth professor of naval history), by whom he had three children.

In Dublin, Haddon was active in marine biology, being secretary of the Dredging Committee, which did much work off the south-west coast of Ireland, and this led to a series of papers, mostly on the Actinozoa, in the *Proceedings of the Royal Dublin Society* and the *Royal Irish Academy*. For some years he divided his time between Dublin and Cambridge, lecturing in Dublin during the winter and spending the summers at Cambridge.

So far there is little evidence that Haddon was anything more than a zoologist of recognized ability, and it was in this capacity that he was sent to Torres Straits in 1888, where he spent nearly a year, though an early interest in decorative art (he was then twenty-five) is shown by a letter to NATURE (23, 9–10; 1880) on the Greek fret. The zoological material brought back from this expedition was published in the *Proceedings of the Royal Society* and in the *Transactions of the Royal Dublin Society*. However significant these results may have been, their importance is entirely eclipsed by the alteration that occurred in the man himself, for it was on this first expedition to Torres Straits that Haddon's interest was largely transferred from marine zoology to anthropology. He would relate how, canoeing with the natives and living very much as they did, he became conscious of the change in their old mode of life, that with this came the conviction that it was his duty to save for science what could be saved, whether of their beliefs, language, or arts and crafts. Haddon was, in fact, in time to save most important evidence both of language and of art—witness the splendid collection of turtleshell masks in the British Museum, and the papers written in conjunction with S. H. Ray on the Torres Straits languages.

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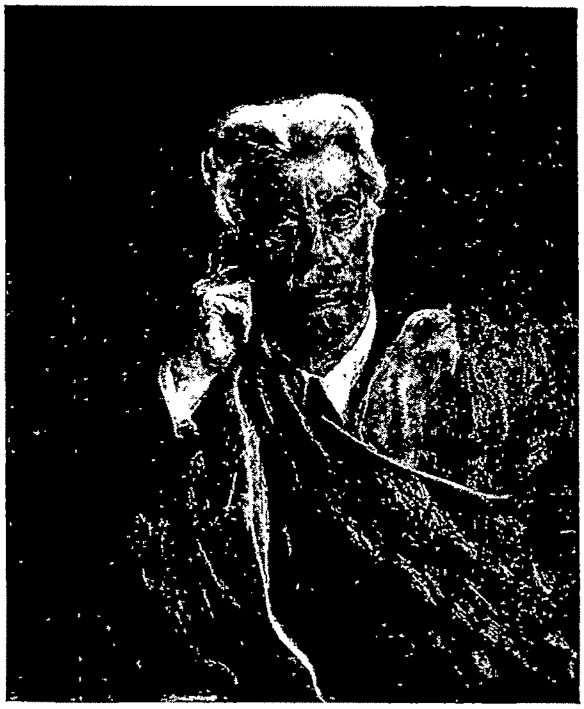
* I wish to thank Miss E. S. Fegan for invaluable assistance in the preparation of this notice.

There was, however, no immediate change of allegiance. When, after his return, Sir William Flower suggested that he should seriously devote himself to anthropology, Haddon, in his own words, "was not very ready to do [so]". There is in existence a most interesting letter written (Nov. 6, 1889) by T. H. Huxley in reply to a request for his advice. "I know of no department of Natural Science more likely to reward a man who goes into it thoroughly than Anthropology. There is an immense deal to be done in the science pure and simple and it is one of those branches of inquiry which brings one into contact with the great problems of humanity in every direction. I once dabbled in it a good deal and I should have liked nothing better than to give myself to it". He goes on to outline the training necessary, and continues: "The only part of your project in which I am afraid to give you any encouragement is the expectation that when the labourer is thus carefully prepared his hire will be forthcoming. I admire Mrs. Haddon's and your pluck immensely, but after all, you know, there is an irreducible minimum of bread and butter, the need of which is patent to a physiologist, if not a morphologist, and I declare with sorrow that—I do not see any way by which a devotee of anthropology is to come at the bread—let alone the butter. And you must recollect (*experto crede*) that the necessity of having to make an income independently of one's proper work—is a frightful burden upon anyone who desires to do that work as it ought to be done. Don't burn your ship in a hurry."



ALFRED CORT HADDON

Reproduction of a portrait by De Laszlo now in the Museum of Archaeology and Ethnology, Cambridge.

Nevertheless, the leaven worked, and Haddon burnt his ship. Finding little scope for his new interests in Dublin, he resigned his professorship within a few years and settled permanently in Cambridge in 1900, having been appointed lecturer in physical anthropology at a salary of £50 per annum the year before. This entailed a considerable financial sacrifice, and he used to allude to this period as one of acute struggle, always emphasizing the encouragement he received from his wife and her constant self-sacrificing assistance.

The idea of revisiting Torres Straits soon crystallized into a definite project, and clearly became an increasing purpose during the next few years. Funds were raised, and on April 22, 1898, the Cambridge Expedition to Torres Straits reached Murray Island, with Haddon as leader. The expedition had from the beginning been planned as something far bigger than a rescue party to a decaying culture, though naturally all possible information bearing on the islanders past and present was collected. It was Haddon who in Great Britain first appreciated the need to study the psychology of 'primitive' peoples, and the importance of that science in relation to what we now call social anthropology. Thus it was that Rivers, McDougall and C. S. Myers became members of the expedition. Here the leader—like so many outstanding men—was ahead of his time; apart from the study of the senses, the psychologists were not yet ready for the anthropologists, nor had more than a limited attention been paid to the unconscious, while the technique of its investigation had scarcely been explored. Nevertheless, this inclusion of psychologists was to lead almost immediately to a most important anthropological development, for it was in the Torres Straits that Rivers elaborated the genealogical method, the most valuable single instrument of investigation that has yet been put into the hands of the social anthropologist. Its importance did not escape Haddon, and in after years he would speak of the conversion of Rivers from psychologist to anthropologist as one of the really important results of the expedition. Haddon did not spend the whole of his time in Torres Straits, but with Ray and Seligman visited New Guinea, where in a few weeks he accumulated an amazing amount of material in every branch of anthropology. On leaving the Straits, he and some other members of the Expedition visited Sarawak, at the invitation of Charles Hose, then Resident of the Baram District.

Election to the fellowship of the Royal Society coincided with Haddon's return in 1899, and from then on his life was so bound up with anthropology as almost to be an epitome of the progress of the science in Great Britain. He was appointed University lecturer in ethnology, becoming reader in 1909 and retaining this post until his retirement in 1926. He was also lecturer in ethnology (Martin White Benefaction) in the University of London during 1904–9. He was president of the Royal Anthropological Institute during 1901–1902, its Huxley Memorial Medallist in 1920, and its first Rivers Medallist in 1924. He was a constant attendant at the meetings of the British Association, presiding over Section H in 1902 (Belfast) and 1905 (South Africa); he was also president of the Folk-lore Society, and of the Cambridge Antiquarian Society. In company with his daughter, now Mrs. Rishbeth, he re-visited Australia and New Guinea in 1914, collecting some fresh material for the "Reports" and greatly increasing his knowledge of Papuasian canoes, knowledge which later led to the publication, with James Hornell, of "Canoes of Oceania".

On his retirement from the Cambridge readership in 1926, he retained his post of honorary curator of the New Guinea collections, which he arranged and catalogued, intending later to do the same for the Borneo material. Leisure from teaching, and intensified contact with museum material, led to the planning of a new work largely concerned with decorative art. This required much museum research —especially in Holland, where he was enthusiastically received—and the MS. of "Smoking and Tobacco Pipes in New Guinea" was completed only a week before his death.

Haddon reviewed for several papers; he was a contributor to NATURE for sixty years, and was the author of countless memoirs and papers, as well as an unusual number of important volumes. This is no place to discuss the Torres Straits "Reports", which he edited and so largely wrote; they speak for themselves. Of his other works, "Iban or Sea Dyak Fabrics and their Patterns" (1936), written in conjunction with L. E. Start, again indicates his persistent interest in decorative art. "Races of Man" (1909, 1924 editions), and "The Wanderings of Peoples" (1911), both illustrate the influence of his zoological training, while the latter book is an exhibition of the extremely condensed style he could at need employ. "We Europeans", written in collaboration with Julian Huxley, is an example of the best form of *œuvre de vulgarization*, produced in the hope of countering some of the insane theories of race now prevailing.

It is surpassingly difficult to give any idea of Haddon the man in a short notice such as this. His strength of build, prominent features, and later his shock of snow-white hair, made him a conspicuous figure in any assembly. Intensely energetic, he had a great capacity for work (in Torres Straits he worked a longer day than any of us), and accuracy of detail seemed to come naturally to him. While the outstanding feature of his character was a broad humanity and kindliness, there was a somewhat unexpected streak of Puritanism, which, however, mellowed greatly as time went on, his wife persuading him to smoke and even to take a drink now and then. He had a keen sense of humour, could be frivolous, and thoroughly enjoyed a holiday as a rest, but in the main his thought and conversation were directed and constructive, and apart from his work he had no hobbies. He was working for an hour or two a day until within a couple of weeks of his death. Far more disinterested than most, there was no one whom he would not go out of his way to help, provided that the claimant was himself doing his best. He hated pretence, and 'side' withered in his presence.

Haddon's work shows a capacity for wide generalizations with, as it seems, a preference for the intensive study of smaller areas in which the intrinsic characters of a people can be compared and contrasted with foreign traits. His method and capacity in this direction are particularly well shown in much of volume 1 (the last written) of the "Reports". It was no doubt his kindliness, tolerance, and honesty of purpose that enabled him to make friends with natives and to gain their confidence in the way he did. "He close up alongside God, he savvy too much" ("too much", that is, a great deal), was the phrase used of him by a Murray Islander, and indeed probably expresses the opinion of all his friends. To have known, appreciated, and been the pupil of A. C. Haddon has been one of my greatest privileges.

C. G. SELIGMAN.

W. R. King

MR. W. R. KING, who died on April 8, aged seventy-two, was Wimshurst's assistant in the development of the Wimshurst electrical 'influence' machine, which of course displaced the frictional machine for the generation of static electricity in the laboratory. This type of apparatus seems to have required quite special skill in the selection and application of apparently simple materials, such as suitable glass and varnishes, necessary for reliability for experiments in static electricity; and Mr. King's experience in this respect was exceptional. The old Nairn machine of Sir Humphry Davy, now standing in the hall of the Royal Institution, owes its restoration to his skill, and he has also carried out similar work for the Science Museum.

In the early days of electrical knowledge numerous and ingenious working models were used to illustrate the behaviour of charged bodies. Many of these were quaint but very striking; Mr. King's collection was unique, and at one of the Friday Evening Exhibitions at the Royal Institution especially, when he showed many of them in action, he easily kept the members interested and delighted to a late hour. He also distinguished himself at the Faraday Exhibition at the Albert Hall in 1931 by a very striking continuous display of lightning from a battery of Leyden jars charged by his largest power machine.

Mr. King's strength had been ebbing for two or three years, continually weakened by bronchial attacks; but he died quietly in his workshop chair. W. J. G.

ROYAL SOCIETY

NEW FOREIGN MEMBERS

M. Le Duc de Broglie

MAURICE, DUC DE BROGLIE, was born in 1875, and has made important contributions to the study of X-rays and the establishment of the now well-known scheme of X-ray electron shells. In 1913, soon after the discovery of the diffraction of X-rays by crystals, he devised a photographic method of investigating X-ray spectra, similar to that developed independently by Moseley in Manchester. During 1920–1922 he used the method of semicircular focusing in a magnetic field to investigate the secondary electrons obtained from these films by the absorption of X-rays. In this way he obtained a direct and beautiful confirmation of the existence of electron energy-levels and of the X-ray quanta. About this time he wrote "Les Rayons X", which was for some years the best account of these phenomena. More recently, the Duc de Broglie has worked on the Brownian movement, on the total reflection of X-rays and on neutron emission. He has served on many committees of the Paris Academy of Sciences, and in 1937 became a member of the Conseil National des Recherches Scientifiques et Industrielles.

Prof. R. G. Harrison

PROF. ROSS GRANVILLE HARRISON, of Yale University, is one of the most distinguished experimental zoologists of to-day. He is probably best known as the originator of tissue culture, his first experiments in this direction being published in 1907. He showed that pieces of the medullary cord of frog embryos could be kept alive in clotted lymph, and he observed the outgrowth of nerve fibres from the explants. Thus he not only originated the method of tissue culture, but also used it, as it should be used, to solve a general problem, namely, that of the mode of origin of nerve fibres. In his later work, he has not by any means confined himself to the tissue culture technique, or even to the problems of the development of the nervous system, important though his contributions to both these fields have been. But, employing grafting methods, he opened up the very important question of the influence of the body of an embryo on the orientation and symmetry of organs grafted into it; and he initiated what is probably the most fundamental approach yet made to the problem of relative growth.

In all these fields, Prof. Harrison's work has been characterized by extreme clarity and precision. His papers are exemplary models, both in contents and presentation, for all young experimental morphologists; and they can be recommended as an antidote to those who think that there can be no exact biology except in those fields within reach of physical and chemical methods; while his Croonian Lecture on the origin and development of the nervous system, given in 1935, is a beautiful example of a broad and penetrating analysis of a biological problem.

Prof. G. N. Lewis

PROF. GILBERT NEWTON LEWIS, of the University of California, is well known for his important experimental researches in electrochemistry. In this field he and his pupils have made some very accurate measurements in difficult fields, including determinations of the electrode potentials of the alkali metals. This work links up with Prof. Lewis's outstanding contributions to thermodynamics, in which he introduced the very original and serviceable conception of the activity. This has been of fundamental importance in the development of the study of strong electrolytes, to which Prof. Lewis and his pupils have made many valuable contributions, and also proved to be very closely connected with the theoretical developments of the subject made by Debye and Hückel.

Another theoretical contribution made by Prof. Lewis was the explanation of covalency as due to electron sharing, and this conception is now firmly established in the modern theory of valency. There are few fields of modern physical chemistry which do not owe something to the highly original and constructive work of Prof. Lewis, and the systematization of thermodynamic data by him and his pupils has also been very important in the application of physical chemistry to industry.

Dr. Francis Peyton Rous

DR. ROUS is a graduate of Johns Hopkins University and has worked at the Rockefeller Institute for Medical Research, New York, since 1909. He is best known for his researches on the problem of transmission of cancer. More than thirty years ago he found a spontaneous sarcoma in a barred Plymouth Rock hen which could be transplanted into other individuals of stock closely related to the fowl in which the growth originally occurred. The fragments of tissue which produced new tumours on injection into other chickens did not contain any visible organisms, and extracts of the ground tumour material produced fresh sarcomata on injection into other fowls even after filtration through apparatus which would retain very small micro-organisms. The tumour, known as the Chicken Tumour I, or the 'Rous sarcoma', retained its distinctive properties whether it was transmitted by a graft of living tissue, by a cell-free filtrate or by dried tumour material, and it is still propagated at the present day. Rous later found many other fowl tumours.

During the last few years Dr. Rous has investigated the Shope rabbit papilloma virus. He has also worked on many physiological problems concerning the liver and blood vessels, the reaction of tissues to injury and vital stains and the preservation of blood. The papers describing the transmissible fowl tumours are classical for accuracy of observations recorded, and for deductions placed on the results.

NEWS AND VIEWS

Imperialism and Service

THE concepts of Empire Day and imperialism were given a new and fuller meaning by H.M. the King in his broadcast address on May 24. He referred in bitter tones to "the spirit of domination and the lust of conquest" to which our enemies give the term imperialism, and he re-defined the term as it now applies to the British Empire. Imperialism, he said, stands for "peace in which our institutions may be developed, the condition of our peoples improved, and the problems of government solved in a spirit of good will". The far-reaching implications of this statement will be readily apparent, and will meet with general approval, for it stamps the British Empire as held together by the strongest but least irksome of bonds, those of friendship and toleration. Of equal significance were His Majesty's words on the consequences of the struggle now in progress. "Defeat will not mean some brief eclipse from which we shall emerge with strength renewed—it will mean destruction of our world as we have known it, and the descent of darkness upon its ruins." All our resources and all our scientific energy are not too much to spend in averting this disaster.

Duddell Medallist of the Physical Society

THE Council of the Physical Society has awarded the seventeenth Duddell Medal to Prof. E. O. Lawrence, of the University of California, Berkeley, for his invention and subsequent development of the cyclotron. Prof. Lawrence, who was born in 1901, went to Berkeley in 1928 and was appointed professor of physics there in 1930. In that year, with M. S. Livingston, he constructed the first cyclotron, which had a comparatively small electromagnet and a pole-gap chamber only six inches in diameter. An 85-ton electromagnet was incorporated in the next cyclotron, designed in collaboration with D. Cooksey; it has an 8-inch pole-gap and a cylindrical chamber 37 inches in diameter. Lawrence was fortunate in obtaining supplies of deuterium oxide from Prof. G. N. Lewis, of the Chemical Department of the University, who had prepared it in quantity. By the summer of 1935, the 37-inch cyclotron had been used to accelerate deuterons to energies equivalent to about 5½ million electron-volts, and 4½ Mev. deuterons had been employed as projectiles for nuclear transformations. Later, 8-Mev. deuterons and 16-Mev. α-particles were produced and used as projectiles to obtain large yields of neutrons from beryllium and also to obtain artificial radioactive elements, for example, 100 millicuries of radio-sodium.

An impressive mass of results has been obtained by Lawrence and his school at Berkeley. Most of them relate to the large number of radioactive isotopes produced by the bombardment of most of the 92 chemical elements with protons, deuterons and α-particles of different energies. Biological effects of neutrons and other products of artificial radioactivity have been studied by Lawrence in collaboration with his brother, Dr. John Lawrence of Yale University Medical School, and wide use has been made of radioactive indicators in the study of metabolism. The new 60-inch cyclotron, with a 220-ton magnet, in the Crocker Radiation Laboratory at Berkeley, has been constructed primarily for biological and clinical purposes, and with it deuterons having energies of about 18 Mev. have been obtained. The Rockefeller Foundation has now undertaken to finance the construction of a 4,900-ton (184-inch) cyclotron, with which it is hoped to accelerate deuterons to energies in the neighbourhood of 100 Mev. With such energies mesotrons may be artificially produced from nuclei.

Prof. F. A. Lindemann, F.R.S.

THE appointment of Prof. F. A. Lindemann as one of the Prime Minister's personal assistants, with particular reference to statistics and research, will be welcomed by scientific workers. Prof. Lindemann, who holds the chair of experimental philosophy in the University of Oxford, has a distinguished record as a man of science and of affairs, going back over the past thirty years. During the War of 1914–18, he was attached to the Royal Air Force and carried out important investigations on spin. Before that time, however, he had done work on the specific heat of solids at low temperatures, and on his appointment to the Oxford chair of experimental philosophy in 1919, he took up investigations on the nature of magnetic storms and on conditions in the upper atmosphere. He has also devised an electrometer now known by his name. Readers of NATURE will recall many contributions in the correspondence columns and elsewhere from Prof. Lindemann and workers in his laboratory. In recent years, Prof. Lindemann has also given much attention to the social consequences of scientific advances. His appointment to a post in close contact with the Prime Minister ensures that the Government will have at hand an adviser who will approach the problems on which he is consulted with full knowledge and appreciation of the scientific method.

Awards of the Institution of Civil Engineers

THE James Alfred Ewing Medal of the Institution, founded in 1936 in memory of the late Sir Alfred Ewing and awarded for specially meritorious contributions to the science of engineering in the field of research, has been awarded for 1939 to Prof. G. I. Taylor, Yarrow research professor of the Royal Society. Prof. Taylor is distinguished for his development of various aspects of mathematical physics, many of which have found applications of great importance in the engineering field. His work on the problem of the turbulent fluid, with special relation to air movements and tides, has furthered knowledge of meteorology, and has been applied to aeronautics, being of material assistance to the fruitful use of the wind-tunnel. He is also a pioneer in the field of research into the conditions in solid bodies during strain, plastic deformation, fatigue, and creep. The practical character of his researches is exemplified by his work on the torsional stiffness of airscrew blades, and he has forged new links between science and engineering to their mutual advantage.

The Sir Charles Parsons Memorial of the Institution, founded in 1936, comprises the erection of a memorial in Westminster Abbey, a Parsons Memorial Library, and an annual lecture on any of the subjects in which Sir Charles Parsons was interested, for which a commemorative bronze medal is awarded. The lecturer for 1939 was Dr. H. L. Guy, who dealt with "Some Researches on Steam Turbine Nozzle Efficiency". Dr. Guy has been the chief engineer of the Mechanical Department, Metropolitan-Vickers Electrical Co., Ltd., since 1919.

Colonial Policy and Scientific Research

NOTWITHSTANDING the preoccupation of Parliament with the grave crisis in the position of the Allies, the second reading of the Colonial Development and Welfare Bill was moved in the Commons on May 21 by Mr. Malcolm MacDonald, Secretary of State for the Colonies in the previous administration. The measure, in spite of an expression from Colonel Wedgwood of his disbelief in the post-War possibility of the financial provision which the Bill proposes, met with the general approval as to its principles from all parts of the House and was read a second time. Mr. MacDonald, in supporting his motion, asked that Parliament, by passing the Bill, should let the world mark our faith in ultimate victory, and our confidence that after the War Great Britain would still exercise vast responsibilities for the Government of colonial peoples. In the subsequent debate Sir George Schuster pointed out that there are no people in the world to whom the success of Germany would be more disastrous than those, for example, in the parts of Africa which we now administer.

That this is no exaggeration may readily be inferred from the Nazi doctrine of the treatment to be meted out to the so-called inferior races. Over against this, Britain may point with justifiable pride to what is unquestionably the most liberal and far-sighted act of policy ever initiated in the history of colonial administration. Not only will the territories under the Colonial Office be relieved of a heavy burden by the remission of £11,000,000 out of their Governments' debt of £15,000,000 to the United Kingdom Exchequer, but also the provision of funds for development and research should ensure that the way to their future prosperity is laid open to them. The provision for research should make it possible to mobilize every resource of science in their service, especially under the leadership of Lord Moyne and Lord Hailey, who, as Mr. MacDonald announced, will act as chairman of the Advisory Committees on Development and Research respectively when these are appointed.

Food and the Housewife

IN a lecture on May 28 at the Royal Institution in the series "The Nation's Larder", Prof. V. H. Mottram pointed out that the housewife who takes an intelligent interest in feeding her family well and according to modern dietetic principles needs some simplified scheme of the facts of dietetics upon which to work. Energy foods are not usually useful for body-building and body-protecting purposes ; body-building foods are often poor as energy and protective foods. Protective foods often have little energy or body-building power. Therefore the foods of one class must not be replaced by those from another class. For example, there is a danger that because we have less meat to eat we may replace it with bread. We must replace it with milk, cheese or fish. Those foods (for example, milk, cheese, fat fish) which combine the functions of two or more classes of foods, are much the most precious foods in diet. The safest rule is first to make sure of the protective foods (dairy foods, greengroceries and the fat fish), add some meat and bacon, and then to satisfy appetite with bread and groceries. Increased consumption of milk, cheese, green vegetables, salad vegetables, fruits and fish such as herrings, sprats, mackerel and salmon (fresh or tinned) is desirable. If this is achieved, it is probable that the energy and even the body-building values of foods will look after themselves. The climate and soil of Great Britain are particularly well adapted to producing protective foods.

Malaria as an Occupational Disease

IN his inaugural thesis (*Thèse de Paris*, No. 707 ; 1939) Dr. J. C. Lévy states that malaria is regarded as an occupational disease, for which appropriate compensation should be made, in certain countries, particularly North America (especially the States of Wisconsin and Illinois), Brazil, Spain and Italy, where its frequency as an occupational disease has given rise to special legislation. In France, on the other hand, there are no legislative measures recognizing malaria as an occupational disease, and compensation for contracting it is allowed only in the case of soldiers, sailors and airmen. Dr. Lévy therefore demands that malaria should be added to the list of occupational diseases in France for the following reasons : first, to repair the material damage to which a variety of workers are liable, namely, colonials and labourers in the veldt or canals, and secondly, for the adoption of additional prophylactic measures in conditions and localities where the work involves the risk of contracting malaria.

The Nature of Virus

DR. THOMAS M. RIVERS discussed the possibilities that viruses represent a transition between living and non-living matter, at a meeting of the New York Academy of Medicine on March 29. A report of the meeting issued by Science Service mentions that the discovery of bacteria was formerly held by some men of science to indicate the origin of life in the world. Many workers now believe this to be the case for viruses. Dr. Rivers discussed the retrograde and the evolutionary vital theories, and also the non-vital autocatalytic ideas of several students of the problem. He pointed out that the weakness of these conceptions is that viruses may not all be similar, and such a plastic group may well embrace all the forms mentioned.

Venereal Disease in the United States

THE United States Public Health Service reports that treatment and laboratory facilities and services in the control of venereal disease increased between 30 and 85 per cent during the last fiscal year ending June 30, 1939. Every State Department now has a separate division or sub-division for the control of venereal disease. Approximately 103,000 persons were discharged from clinics as cured or the disease arrested in 1939, as compared with 78,000 in the previous year. Persons treated for the first time numbered 305,000 and the number of treatments administered was 8,000,000. Training centres for physicians and nurses in venereal disease control have been established in nine universities.

Earthquakes in Peru

AN earthquake on the night of May 24 did considerable damage to the towns of Lima and Callao in Peru. A dry dock and pier at Callao were damaged, part of a building belonging to the College of St. Thomas Aquinas collapsed, and hundreds of other buildings were destroyed. Two aftershocks of some severity followed on May 25. As a result of the shocks it is estimated that there were 300 dead and 1,500 injured in the two towns, though detailed information is lacking owing to the temporary severing of communications with the area as a result of the earthquakes. Although the whole of Peru is subject to minor earthquakes and earth tremors, the present epicentre appears to be farther north than the most seismic district in Peru, namely, the regions around Arequipa. On January 8, 1725, an earthquake with its epicentre near Arequipa caused widespread destruction and damage was caused in Lima. In the present instance no news has yet been heard of Arequipa. Slight tremors, possibly sympathetic with the above, have also been felt at Guayaquil in Equador.

Agricultural Work for University Students

A SCHEME has been prepared by the Ministry of Agriculture and Fisheries to encourage students at universities and colleges to undertake agricultural work during the summer vacation. Recruiting bureaux have been set up at the principal universities, where full particulars of the scheme and application forms may be obtained. Volunteers will receive at least the appropriate minimum wage-rates fixed by the local agricultural wages committee. This particular scheme is intended for men only, but the Minister also appeals to women students who are willing to spend four weeks or more on the land to join the Women's Land Army Auxiliary Force, particulars of which may be obtained from the local county secretary of the Women's Land Army, or from the headquarters at Balcombe Place, Balcombe, Sussex.

The Parliamentary and Scientific Committee

AT a meeting of the Parliamentary and Scientific Committee at the House of Commons on May 22 it was decided in view of the grave situation to hold regular weekly meetings in future to examine all ways by which a greater application of scientific knowledge could be applied to the conduct of the War in its various aspects and to bring these matters to the immediate notice of the appropriate Ministers. The first of these meetings was held at the House of Commons on May 29.

Announcements

AT the anniversary meeting of the Linnean Society of London held on May 24 the following were elected officers for the year 1940–41 : *President*, Dr. E. S. Russell ; *Treasurer*, Mr. Francis Druce ; *Secretaries*, Mr. I. Henry Burkill (botany), and Dr. Malcolm Smith (zoology). The new members of the Council are Mr. J. S. L. Gilmour, Mr. J. R. Norman, Dr. C. F. A. Pantin, Dr. E. S. Russell and Major F. C. Stern.

SPECIMENS of a rare nickel-iron sulphide mineral, bravoite from Mill Close Mine, Derbyshire, have been presented to the Department of Mineralogy of the British Museum (Natural History) by Prof. W. G. Fearnsides. This is the first known occurrence of the mineral in the British Isles.

THE attainment of the Government's ploughing-up objective in Great Britain and Northern Ireland was announced on May 23 in the House of Commons by the Minister of Agriculture and Fisheries. The total additional grassland ploughed amounts in England and Wales to 1,542,236 acres—an excess of 42,000 acres over the target programme of 1½ million acres. When the figures for Scotland (about 222,000 acres) and Northern Ireland (about 270,000 acres) are added, a grand total of 2,034,236 acres is obtained.

THE Association for Education in Citizenship is organizing a Summer School at Lady Margaret Hall, Oxford, during August 7–14, the subject for discussion being "Education for Effective Democracy". Further information can be obtained from the Association for Education in Citizenship, 10 Victoria Street, London, S.W.1.

THE Brighton Summer School in Animal Biology will be held during August 3–15 at the Municipal Technical College, Brighton, under the direction of Prof. L. E. S. Eastham. Further information can be obtained from Mr. F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 863. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Universities and Research

THE leading article in NATURE of April 27 opened with a paragraph which purported to give the reasons for university authorities encouraging their staffs and students to do research work : ". . . the *principal* reason, especially applicable to the students, probably being that research is excellent educational training and therefore falls within the sphere of the primary activity of universities. A *secondary* reason, especially applicable to the staffs, is that research may produce results of great *public* benefit and is, *to that extent, not inconsistent with* the reason for existence of universities" (italics mine).

It may be that the writer (whose main concern in this article was with patentable discoveries) had to express himself in this introduction with a hard-and-fast conciseness which has misled me, and which he might have wished to elucidate if he had had more space. But I will own that his words quoted above, especially those which I have italicized, stirred in me a feeling of dissent, akin to that roused in many of us who live and have our being in universities by certain publicists (and even by writers in NATURE) who of late years have attempted to gauge and guide our work by standards which we feel are faulty. The passage seems to ascribe to "university authorities" grudging and illiberal ideas about academic research which, to my knowledge, many of them do not hold. Others of them would, I believe, consider that the statement begs large questions, and they would not be ready to endorse it without changing at least the balance of its emphasis. Some—but, I think, very few—might give it a casual and more or less cynical assent. On the other hand, many people whose working life does not make them "university authorities", and whose view of our universities is limited or external (with, usually, some background of former studentship in one of them), would subscribe to the statement. If the following different statement puts little that has not been said before (and criticized) about academic research and university authority, perhaps I may preface my own excursus on these two matters by borrowing, in a modest way, the classic retort of some advocate of honesty as the best policy—"I have tried both".

In normal times, and where thought and speech are free to all who can think and speak, spontaneous inquiry must be free to all who can inquire. The primary activity of a British university is the cultivation of informed inquiry and the development of its techniques. The training stages of this—by which stages I mean all undergraduate curricula and the postgraduate studies—must go on inseparably within the same walls as a maturer use of the diverse and changing techniques if either sort is to be kept alive. Without that continued and equal coupling, universities cannot do their teaching duty to the ordinary undergraduate, or their duty (inherent in no other system of institutions) as the nurseries both of new knowledge and of the men to make it.

As to the public benefit of such new knowledge : a university may sometimes find it easier to get from non-academic sources money for researches which have an immediate and obvious public use, than to get it from them for other inquiries. This is, however, not usually the case; for as a rule the former kinds of research are the more expensive, and there are also alternative homes for them. But, as need scarcely be said, immediate public utility is not the standard by which university authorities measure the value of university researches ; nor by that scale do they mete out such encouragement as they are privileged to give to true investigators, whether these are scientific, or technological, or work in the domains of letters and scholarship.

In time of peace to insist, as various people have tried to do of late years, that the active curiosities of original minds shall be turned aside to topics selected by non-practitioners or lay arbiters as bearing on current public problems ; to constrain into 'practical' themes men of highly specific abilities, whose reason for living hard and (by newspaper standards) inconspicuous lives is that they crave to know certain sorts of unknown things and can endure the long process of finding out : all this is a kind of regimentation which would frustrate its own ends. For the mind of the genuine researcher (as distinct from imitations, here negligible) simply will not work productively upon things in which it is not technically interested, or on 'problems of the day' which he knows are too crowded with shifting and arbitrary variables to be resolved by means of his specific aptitudes. Each researcher is a key that opens only the range of locks which it fits. His own results are normally what the public calls 'useless', because they are beyond the horizon of even the educated contemporary layman, and because the integrated effects of them and their like will not reach the surface of public apprehension for a long time to come. That future time would be intellectually sterile, *its* educated laymen atavisms instead of our heirs, but for present-day 'academic' work, wherein the investigator follows the inspirations of his own instructed nose, and not the noses of those who plunge about after more noticeable scents.

If these views are called reactionary, I do not much care, so long as I am not thought by implication to decry the doing of applied research by all who can do it well. (Invention is another matter.) But I myself think those people reactionary who have lately been preaching that academic scientists are unsocial irresponsibles, wreaking they know not what in a world which they ignore, and that their talents should be turned upon public affairs. That is an old and seductive song; its dwindling had been an improvement, its renewal in time of peace was a backward and a timorous move. In war, of course, the deflection of research ability to short-focus utilitarian questions is necessary; and it is valuable to the nation in measure as the specific aptitude and the common sense of each worker are properly noted in allotting him his war task. Afterwards, he will return again, if he can, to his work as an active philosopher; and no doubt he will yet again be grudged the exercise of that function—but not by university authorities.

J. I. O. MASSON.

The University,
Sheffield.
April 30.

Vitamin B_1 and Acetylcholine Formation in Isolated Brain

WE have shown in earlier papers[1] that in the presence of glucose or of pyruvate and under aerobic conditions brain tissue, whether sliced or minced, synthesizes acetylcholine. In the absence of such substrates, little or no synthesis takes place. Since it is well known from the work of Peters and his colleagues that the presence of vitamin B_1 (as cocarboxylase) is necessary for the oxidation of pyruvic acid in brain *in vitro*, it becomes of interest to discover whether the presence of vitamin B_1 has any influence on the rate of acetylcholine synthesis in isolated brain tissue. MacIntosh[2] investigated the acetylcholine contents of brains of polyneuritic pigeons and found these to be of the same order as those in the brains of normal pigeons. We have examined the abilities of intact brain slices, from normal and polyneuritic pigeons, to synthesize acetylcholine under suitable aerobic conditions in bicarbonate – Locke – pyruvate media containing eserine. (The eserine is added to prevent the decomposition of the acetylcholine by the choline esterase in the tissue.) We have found no appreciable difference between the rates of acetylcholine formation in normal or polyneuritic brain tissue examined under these conditions; nor have we found as a general rule that the addition of vitamin B_1 has any significant effect upon these rates. (On one occasion we found that the addition of vitamin B_1 definitely increased the rate of acetylcholine formation by polyneuritic pigeon brain in a phosphate–pyruvate medium.)

Quite a different result, however, is obtained if the brain slices are examined aerobically in a bicarbonate – Locke – pyruvate – eserine medium containing a relatively high concentration (0·03 *M.*) of potassium ions. Under these conditions polyneuritic pigeon brain synthesizes acetylcholine at a smaller rate than in the case of normal brain. The addition of vitamin B_1 to the polyneuritic brain restores the rate of acetylcholine formation to the normal. The addition of vitamin B_1 to the normal pigeon brain, on the other hand, has no significant effect on the rate of acetylcholine formation. Typical results are shown in the accompanying table, where total acetylcholine was estimated by the technique described in our papers.

PIGEON BRAIN SLICES IN BICARBONATE (0·025 *M.*)—LOCKE–ESERINE (1/6,000)–PYRUVATE (0·01 *M.*) MEDIA. INCUBATED FOR 1½ HOURS AT 37° IN AN ATMOSPHERE OF 95 PER CENT OXYGEN + 5 PER CENT CARBON DIOXIDE

	Condition of pigeon	K+ concentration added to that in basal medium	Amount of vitamin B_1 added	Total acetylcholine Cl formed. γ/gm. wet weight of brain tissue
Expt. 1	Normal	Nil	Nil	9·8
	,,	Nil	4 γ	9·6
	,,	0·03 *M.*	Nil	27·0
	,,	0·03 *M.*	4 γ	24·8
Expt. 2	Normal	Nil	Nil	13·5
	,,	0·03 *M.*	Nil	26·7
	,,	0·03 *M.*	4 γ	24·1
Expt. 3	Polyneuritic	Nil	Nil	7·5
	,,	Nil	4 γ	7·4
	,,	0·03 *M.*	Nil	14·0
	,,	0·03 *M.*	4 γ	24·6
Expt. 4	Polyneuritic	0·03 *M.*	Nil	18·8
	,,	0·03 *M.*	4 γ	29·8
Expt. 5	Polyneuritic	0·03 *M.*	Nil	17·2
	,,	0·03 *M.*	4 γ	26·2
Expt. 6	Polyneuritic	0·03 *M.*	Nil	15·2
	,,	0·03 *M.*	4 γ	23·4

To explain this phenomenon (see ref. 1), it is important to point out that the total acetylcholine, measurements of which are given in the accompanying table, is made up of the sum of bound and free acetylcholine. The quantity of bound acetylcholine which is formed cannot exceed a certain value, this being determined by the amount in the cell of a (? protein) component which enters into the constitution of the bound acetylcholine. Free acetylcholine arises by breakdown of the bound ester, and the amount of free acetylcholine is determined by the rate at which the bound form breaks down to produce the free ester. An equilibrium exists in the cell between the concentrations of bound and free esters. Normally the rate of formation of bound acetylcholine is much faster than the rate of liberation of free acetylcholine, but, as stated before, not more than a limited quantity of the bound ester can be synthesized. It is therefore understandable that a diminution in the rate of synthesis of the bound ester may take place without affecting the final quantity, or the limiting concentration, of bound acetylcholine in the cell. Hence the rate of formation of total acetylcholine may be independent of small changes of the rate of synthesis of the bound ester. In the presence of relatively high concentrations of potassium ions, however, the rate of formation of free acetylcholine is greatly increased, presumably by an increased rate of diffusion through the cell wall[1]. In this case a relatively small fall in the rate of synthesis of the bound ester may be such as to prevent the attainment of the limiting concentration of the bound acetylcholine, owing to the increased rapidity with which the latter is being broken down. Under such conditions the rate of synthesis of bound acetylcholine determines the rate of formation of total acetylcholine. It is in these circumstances that we may hope to see pronounced effects, on the rate of acetylcholine formation, of changes of pyruvate metabolism in the brain caused by variations of vitamin B_1 content.

The experiments the results of which are recorded in the accompanying table show clearly that the presence of vitamin B_1 affects the synthesis of acetylcholine by polyneuritic brain in the presence of pyruvate. In the absence of substrate we have observed no accelerating action due to the action of vitamin B_1. Hence the action of vitamin B_1 on acetylcholine synthesis is linked with pyruvate metabolism. It is, however, uncertain whether the effect of the vitamin is to be attributed to its influence on pyruvate oxidation or upon some other phase of pyruvate metabolism in the nervous system.

P. J. G. MANN.
J. H. QUASTEL.

Biochemical Laboratory,
City Mental Hospital,
Cardiff.
May 3.

[1] Mann, Tennenbaum and Quastel, *Biochem. J.*, **33**, 822, 1506 (1939).

[2] MacIntosh, *J. Physiol.*, 96, 6P (1939).

Amino-Acids of Casein Phosphopeptone

THE proof of any hypothesis of protein structure must in the last resort be based upon the isolation of partial cleavage products of definite composition, ranging in complexity from the amino-acid to the intact protein, and the elucidation of their constitution. From this point of view the phosphorus complexes formed from casein by enzymic digestion provide attractive material for investigation, as the phosphorus serves as a helpful label for isolation identification.

Rimington[1] isolated a trypsin-resistant phosphopeptone from casein which he claimed was made up of 3 mol. of hydroxyglutamic acid, 4 mol. of hydroxyaminobutyric acid and 2 mol. of serine. However, on several grounds, the problem appeared to require re-investigation. In particular it may be mentioned that Harington[2] has been unable to identify hydroxyglutamic acid as a constituent of casein.

By digesting with trypsin the precipitate of 'paranuclein' (obtained by the action of pepsin on casein, and containing about 50 per cent of the total phosphorus of the protein), a phosphopeptone of constant composition resistant to the further action of trypsin is formed. The substance, isolated as the barium salt which is insoluble in 50 per cent alcohol, has an amino-N content of 10 per cent and a N : P ratio of 3·2 to 3·3, indicating a polypeptide made of 10 amino-acids united to three phosphoric acid residues. Analysis of the products of hydrolysis carried out on many separate samples shows the amino-acid composition to be: 3 mol. of glutamic acid, 3 mol. of *iso*leucine, and 4 mol. of serine.

The glutamic acid was isolated either as the hydrochloride or by precipitation with barium hydroxide and alcohol according to the modified Foreman method[3], the yields being 29·7 and 28 per cent respectively of the total nitrogen. The yield of *iso*leucine (separated by means of butyl alcohol extraction[4] followed by conversion to copper salts[5]) was 27·9 per cent. For the separation of serine, fractional crystallization was the only serviceable method and the best yields came to only 13·1 per cent of the total nitrogen. However, by oxidation of the hydrolysate with chloramine-*T* and gravimetric determination of the glycollic aldehyde formed as the 2 : 4-dinitrophenylosazone the serine present was also found to account for 28·9 per cent of the total nitrogen of the phosphopeptone. 10·9 per cent of the total nitrogen was present in the hydrolysate as ammonia. From the time course of ammonia liberation in the presence of dilute acids[6] it has to be concluded that the ammonia arises not from an amide group but from secondary decomposition, most probably of serine. This is supported by the fact that glyceric acid can be isolated from ether extracts of the hydrolysate in the form of its quinine salt. Small amounts of pyruvic and lactic acids also appear to be formed. The absence of any hydroxyamino-acid other than serine has been established by oxidation of the various fractions by means of chloramine-*T* and the identification of the osazones formed with phenyl, *p*-nitrophenyl, and 2 : 4-dinitrophenyl hydrazine. Only glyoxal osazone was formed.

Certain difficulties in the analytical procedure caused by the presence of serine are worth special mention, as they are of general significance in protein analysis and also throw some light on the alleged isolation of hydroxyglutamic acid. Under the usual conditions of precipitation of the dicarboxylic acids by barium or calcium hydroxide and alcohol, serine is also precipitated to a considerable extent. Glyceric and pyruvic acids formed by the secondary decomposition of serine are similarly precipitated; these acids interfere further in the estimation of dicarboxylic acids by titration also. In distinguishing the hydroxyamino-acids by oxidation with chloramine-*T* it has to be remembered that the melting points of the *p*-nitrophenylosazones are not suited for identification; the phenylosazones are more serviceable.

Full experimental details will be published elsewhere. The question of the order in which the amino-acids are present in the phosphopeptone is being now investigated.

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Cancer Cell and Growth-Regulating System of the Body

A FRAGMENT of tissue removed from the body and explanted *in vitro* does not commence growing immediately. A certain period of time must elapse before proliferation sets in. In a paper some years ago which has been overlooked in the literature on tissue culture, Cohn and Murray[1] reported that the period between the moment that the tissue fragment is explanted *in vitro* and the first appearance of new cells varies with the age of the embryo. As the embryo develops, this latent period becomes progressively longer. The latent period of adult tissue explanted *in vitro* is considerable as compared to that of embryonic tissue. We have demonstrated[2] that it is approximately three times longer than that of tissue taken from an embryo in a late developmental stage. Furthermore, we have shown that during postnatal growth the latent period increases gradually[3]. It reaches its maximum when the animal ceases growing and remains constant thereafter, not even changing during senescence[3,4].

The fact that after explantation a definite period must expire before proliferation sets in may be explained by assuming that the growth-inhibiting factors which act in the organism remain active for a certain length of time outside the body. The progressive increase of the latent period, corresponding to the successive developmental stages of the growing animal in embryonic and post-natal periods, could then be due to an increase in the forces which oppose cell multiplication in the organism. This explanation of the significance of the latent period and its variations is based on the hypothesis that tissue stability in the body is a result of the balance between the growth-proliferating and -inhibiting mechanism (Murphy[5]).

In the light of the above conception, we thought it important to investigate the latent period of neoplastic tissue explanted *in vitro*. The experiments here reported were carried out with explants from benzpyrene sarcoma of rats and Rous sarcoma of chickens. The tumour fragments were planted in Carrel flasks containing plasma diluted with double its volume of Tyrode solution and one drop of dilute embryonic extract. The flasks were kept in the incubator at 37° C. and examined at regular intervals. The time was noted when the first cells appeared on the margin of the explanted fragment.

A total of 490 explants from 14 tumours (9 rat sarcoma and 5 Rous chicken sarcoma) were used in these experiments. All the explanted fragments commenced to proliferate *in vitro* following a latent period which was very much shorter than that of normal adult tissue. Whereas in normal adult tissue the latent period ranges from 18 to 28 hours, in neoplastic tissue it never exceeded 8 hours. Moreover, it must be emphasized that in about half of the experiments the first cells appeared on the margin of the tumour fragments after 40–50 minutes—that is to say, practically without any latency. This absence of a latent period places tumour tissue in a unique position compared with all other tissues, normal adult as well as embryonic tissue. Even early embryonic tissue, taken from 6–7 day old embryos, always has a latent period of between 1½ and 4 hours.

The fact that explants of tumour tissue begin to grow *in vitro* after a very short, or even without any, latent period affords evidence of the unique position of tumour tissue with regard to the growth-inhibiting mechanism of the organism. We see herein experimental proof for the conception, increasingly gaining favour, that "what distinguishes a malignant cell from a normal cell is its freedom from control by the organism to which the normal cell is subjected" (Cramer[6]).

A detailed report will be published elsewhere.

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Serological Properties of Extracts of Hæmolytic Streptococci prepared by Ultrasonic Vibrations

IT has been shown[1] that in order to produce protective sera of high potency against hæmolytic streptococci the vaccines employed for immunization have to be prepared from cocci cultivated for a few hours only. While such young cocci are well capsulated, the capsules are lost after the early stage of growth. The assumption seemed therefore justified that an antigen contained in the capsular substance is responsible for the production of protective antibody. Since it is also known[1] that this antigen is highly labile and easily altered by chemicals or excessive heat, in any attempt at its isolation a method must be used which interferes as little as possible with the constitution of the antigen. Disintegration of streptococci by sonic vibrations of audible frequency has previously been described by Chambers and Flosdorf[2], and Mudd and collaborators[3,4] have used this method for the extraction of labile antigen. The results of these workers have, however, no direct bearing on the problem of the streptococcal capsule as they employed 'overnight' cultures only in their investigations. It was thought that disintegration of the cocci by means of ultrasonic vibrations would liberate the antigen unaltered.

This expectation was tested in the following manner. A suspension of the streptococci was hermetically sealed in thin-walled glass test-tubes and held in an oil bath containing a powerful quartz piezo-electric oscillator operating at 550 kilocycles per second. The ultrasonic generator has already been described and is the same as that employed by Hopwood and Gordon[5] and by Hopwood, Salaman and McFarlane[6] in their experiments on vaccinia virus.

Preliminary experiments were undertaken to find out how long the streptococci had to be exposed to the vibrations under the experimental conditions in order to be deprived of their capsules. This time was found to be about four minutes when 5 c.c. of a suspension of streptococci in saline made up from the sediment of 100 c.c. of a 2 hours-culture was used. For the main experiments six minutes was chosen as the time of exposure.

The periods of irradiation were always interrupted to permit the cooling of the suspensions in a bath of ice water, and so prevent any undesirable rise of temperature.

After the exposure the suspension of streptococci was centrifuged and the supernatant portion filtered through Berkefeld V candles. Immune sera precipitated these crude extracts prepared from young as well as from overnight cultures, but an extract prepared from a well-capsulated young culture was still precipitated by the homologous immune serum after absorption with the sediment of an overnight culture. A similar quantity of young cocci completely exhausted the serological activity of the serum. Attempts to isolate and purify the type-specific antigen from extracts prepared from young and overnight cultures respectively also showed that the amount of type-specific antigen present in ultrasonic extracts was larger when these were prepared from young cultures. The type-specific antigen of Group *A* hæmolytic streptococci having the characteristics of a nucleo-protein is precipitated by weak solutions of acetic acid. In the case of a Type 3 streptococcus in the non-mucoid phase, precipitation of ultrasonic extracts with acetic acid yielded serologically active material only when the extracts were prepared from young cocci. With streptococci of Types 3 and 13 in the mucoid phase, however, the first precipitation with acetic acid yielded active material from extracts both of young and overnight cultures. Further purification led finally to fractions where serologically active substance was demonstrable only in those derived from young cultures.

The result of these experiments is in favour of the assumption that fully capsulated young cultures of hæmolytic streptococci provide a better antigen than overnight cultures owing to their larger content of unaltered type-specific antigen. However, since the disintegration of streptococci by ultrasonic vibrations liberates serologically active material not only from the fully capsulated cocci, but also from those possessing no demonstrable capsule, these observations, though very suggestive, cannot be taken as conclusive proof that the type-specific antigen of streptococci is situated only in the capsule.

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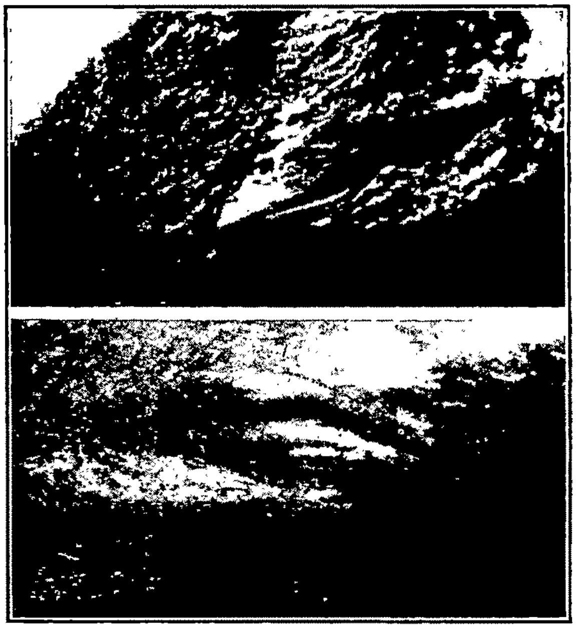
Upper Canine Teeth in the Indian Antelope (*Antilope cervicapra*)

UPPER canine teeth do not persist in either sex throughout the Bovidæ, but the occurrence of these teeth even in young animals at any stage of development has seldom been recorded. Regarding the antelopes, Forsyth Major in 1904[1] stated that "deciduous upper canines have not often been recorded. . . . I can find only five writers who mention them". He himself added notes upon their presence in five species, mostly in very young or fœtal individuals, and came to the conclusion "that calcified rudimentary milk-canines will be found to be normally present in all fœtal and most very young Antelopes, and that it is owing to the scarcity of fœtal and very young skulls in our Museums that they have not been observed more frequently" (p. 422).

At various times I have received from the Park of the Zoological Society of Scotland the bodies of three Indian antelopes or black buck (*Antilope cervicapra*) which have died at or within a few days of birth. In one individual (1937. 15. 21), three days old, rudimentary upper canines were present, but were lost during the process of macerating the skull; in a second (1937. 15. 2), which died just after birth, well-formed and definitely edged open alveoli are present, and although no teeth were seen the alveoli indicate that rudiments must have existed. In the prepared skull of the third specimen (1940. 8), one day old, no alveolus was visible, but dissection revealed the presence in each jaw of a rudimentary canine, 4 mm. long, lying almost parallel to the free edge of the maxilla, and showing in median section a large pulp cavity (see accompanying figure). There is only one record of the presence of rudimentary upper canines in the Indian antelope, by Nehring[2], who, in parenthesis, remarks that in the upper jaw prepared by him from a young individual which died in a zoological garden, two well-developed canine teeth were present.



DISSECTIONS SHOWING RUDIMENTARY UPPER CANINE TEETH OF THE INDIAN ANTELOPE (× 7·5). ABOVE, LEFT JAW, TOOTH IN MEDIAN SECTION: BELOW, RIGHT JAW, SAME SKULL, EXTERNAL ASPECT OF TOOTH.

The result of the examination of three additional skulls of the Indian antelope suggests that in that species rudimentary upper canines may be present in all fœtal individuals, although they do not cut the gum and may scarcely reach the level of the surface of the maxilla. This evidence supports Major's belief that rudimentary canines will be found in all fœtal or very young antelopes. On the other hand, Lönnberg[3] has examined eight very young skulls of different species in the collections of the Natural History Museum at Stockholm without observing "a single indication of upper canines or traces of alveoles after such". It is possible, however, that even in these cases dissection would have shown the presence of rudimentary canines. Lönnberg describes moderately well-developed upper canines in a young skull of *Gazella granti* from East Africa.

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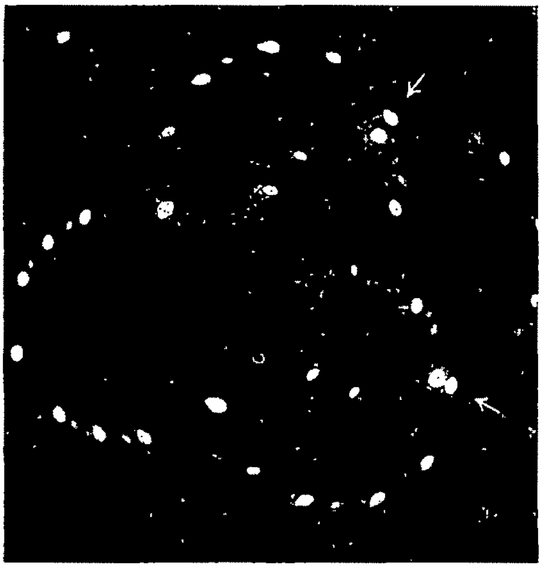
Reflection of X-rays with a Change of Frequency

A change of frequency in the scattering of light or of X-rays is a familiar phenomenon. On the other hand, the coherent X-ray reflections given by crystals are a consequence of classical optics and any change of frequency in such reflection might seem inadmissible. A closer consideration shows, however, that even on the classical theory, a change of frequency might accompany a coherent reflection, if the structure-amplitude of the crystal planes responsible for the reflection were to vary periodically with time. This would occur, for example, when the interpenetrating lattices in the crystal oscillate against each other with the characteristic infra-red frequencies and produce pulsations of the electron-density in the crystal. On the principles of the quantum theory, therefore, such lattice oscillations, though initially non-existent, may be excited as the result of the incident radiation and give rise to a *coherent reflection of altered frequency*.



Laue Pattern of Sodium Nitrate.

Consider the effect on a beam of monochromatic X-radiation passing through a crystal of a set of spacings having a large structure-amplitude. If the angle of incidence on these spacings is different from that given by the Bragg formula, the usual type of X-ray reflection would be forbidden. A periodic variation with time of the structure-amplitude, *if it has the same phase throughout the crystal*, would also fail to give rise to a reflection with modified frequency. In other words, reflections with and without modification of frequency would occur only in accompaniment with each other. On the other hand, if the variation of structure-amplitude has not the same phase everywhere, the two types of reflection may occur independently. While the unmodified reflections could appear only at the correct Bragg angle of incidence on the crystal spacings, the modified reflections would not be restricted to such incidences. The direction in which they appear would correspond with that of geometric reflection, *not from the crystal spacings*, but from the plane waves of constant phase of the structure-amplitude variations. The inclination of these waves would, in fact, be uniquely determined by the circumstances of each reflection, as these must satisfy the Bragg condition as well. In other words, on the quantum theory, only that particular mode of oscillation would be excited which would give the observed reflection.

A crystal of sodium nitrate gives excellent examples of these modified reflections. The accompanying illustration is a Laue pattern obtained with such a crystal, the direction of the incident X-ray pencil (from a copper target) being normal to one of the three pairs of the rhombohedral cleavage faces and therefore equally inclined to the other two pairs of such faces. Along the two radial lines marked in the figure will be seen following each other in order, the usual Laue reflection from the cleavage spacings and the modified reflections corresponding to the incident copper K_α and copper K_β monochromatic radiations. Still nearer the centre will be seen the faint radial streaks corresponding to the modified reflections of the incident white radiations.

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Fission of Uranium and Thorium under Deuteron Bombardment

In continuation of the experiments on uranium fission under deuteron bombardment reported by Gant[1] from this laboratory, we have carried out a chemical separation of the recoil products. The particles projected from the uranium target under deuteron bombardment were collected on an aluminium foil using the experimental arrangement described by Gant. The foil was then dissolved in aqua regia and, after adding the necessary carriers, platinum, barium and lanthanum separations were made in the usual way. The activities observed were 15 min., 1 hr. and 30–40 hr. with the platinum fraction, 11 min. and 80 min. with the barium fraction, and 4 hr. with the lanthanum fraction. Some of the periods are thus found to correspond to those obtained with neutron fission in uranium[2], in agreement with Gant's conclusion that 9 Mev. deuterons are capable of producing fission in uranium. Control experiments with lead and bismuth targets failed to show any appreciable activities in the carriers.

Using the same experimental arrangement as before, we have bombarded thorium with 9 Mev. deuterons, a thin layer of metallic thorium being used as the target. Seven minutes after a $6\,\mu$ amp. min. bombardment, an aluminium foil F (3·3 mgm./cm.^{2}), which had been placed inside the side pocket of the target box and protected from the low-energy products due to mechanical disintegration of the target by 2 mm. S.P. aluminium, gave an activity of about 1,200 counts per min., whereas a second aluminium foil D which was placed behind the foil F and therefore measured the scattered deuteron effect, gave an activity of 100 counts per min., decaying with the well-known 2·4 min. period of ^{28}Al. The activity produced in a third aluminium foil N, placed inside the pocket but separated from the foil D by a copper sheet (½ mm. thick), was of the order of 20 counts per min. The activity of *F* was found to decay with a composite period, the decay curve agreeing with that calculated from Frisch's formula[3]. With a target entirely of lead, *F* as well as *D* showed only a small effect. Replacement of the aluminium foil as a collector of fission products by pieces of ciné film did not appreciably affect the activity of *F*.

The magnitude of the fission effect caused by the background neutron radiation produced at the target was assessed by measuring the neutron-induced fission in a second thorium target enclosed in the side pocket and safely protected from the scattered deuterons. After identical bombardments, the activity on an aluminium collector placed in front of the second thorium target and separated from it by aluminium of 2 mm. S.P. was less than one thirtieth of that observed in the case of direct deuteron bombardment.

The maximum range of the radioactive nuclei projected from the thorium target under 9 Mev. deuteron bombardment was found to be equivalent to about 1·8 cm. of air. Excitation function measurements showed that the threshold for deuteron fission of thorium is at about 7·5 Mev. and that the fission cross-section increases rapidly between 8 and 9 Mev.

Chemical separation of the deuteron-induced fission products of thorium gave the following periods: platinum fraction, 18 min. and 2½ hr.; barium fraction, 15 min.; and lanthanum fraction, 2·5 hr.

Comparison between the fission cross-sections of uranium and thorium for 9 Mev. deuterons showed that for thorium the cross-section was about two thirds of that for uranium.

We wish to express our gratitude to Mr. D. H. T. Gant for lending us his apparatus and also for valuable suggestions.

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Change of Ultra-Violet Transparency of Glass with Temperature

The transmission of ultra-violet light by glass in the region of 3000 A. has long been known to be reduced when the glass is exposed to light, and restored by heating to 250–300° C. Slow restoration also takes place when the glass is kept in the dark.

Another effect has been examined, not to be confused with the first, whereby the absorption coefficients of glasses are found to vary very appreciably with temperature in the region of wave-length close to the ultra-violet limits of transparency of the glass. The effect is immediately reversible, and over the range 10°–50° C., the relation absorption coefficient – temperature is strictly linear, and in all cases absorption coefficient increases with increase in temperature. The specimens of glass were kept at known temperature in a vessel with quartz windows top and bottom. Through this vessel water was passed, the temperature of which was controlled by a small electric heater.

3300 A.

Glass	Absorption coeff. per cm. thickness		Percentage variation per ° C.	
	3300 A.	3110 A.	3300 A.	3110 A.
'Vita'	0·121	0·578	0·48	0·38
Pilkington's 'White'—Sample 2	0·426	1·67	0·49	0·39
Patent plate—Sample 5	1·59	—	0·47	--
Pilkington's 'White'—Sample 4	0·482	—	0·38	---
Ordinary microscope cover glasses	1·69	6·10	0·34	0·24
Ordinary photographic plate glass	0·925	5·14	0·66	0·46

With the particular spectrophotometer used, only three wave-lengths were available, and assuming for the longest, namely, 4500 A., a negligible absorption for all the glasses used, the values of absorption coefficient per cm. thickness and percentage increase per degree centigrade (shown in the accompanying table) were obtained for light of 3300 A. and 3110 A.

During a control experiment without glasses but with tap water at various temperatures, the spectrophotometer readings were constant.

The percentage change of absorption coefficient with temperature was found in the first three widely different glasses to be constant for a given wavelength, and it was thought that if this should hold for all glasses, then the effect might be due to a single impurity—possibly iron—present in them all in varying amounts. However, the later specimens gave results which were rather different, so it seems that more than one substance in the glass contributes to the effect.

It follows from the above results that, for work involving the absorption of ultra-violet light by glass filters, it is necessary to keep the filters at a known temperature constant to about 1° C. for reasonable accuracy to be obtained.

This effect may be known to some people, but it does not seem to be generally recognized, and little reference to it can be found in published works.

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The Ridings,
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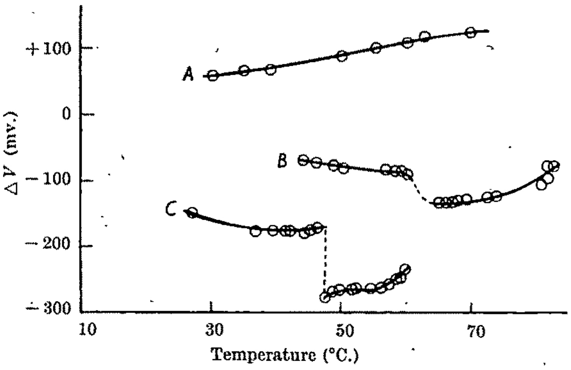
Surface Potential Changes of Thin Films in the Transformation Liquid to Solid

In an investigation on the oxidation and polymerization of polymerizable glycerides, it appeared feasible to follow the polymerization accompanying the oxidation by measuring the change of potential at the gas/liquid interface, as the liquid phase passes abruptly to a solid or gel phase. This has been successfully accomplished. From this it was considered that similar changes in surface potential might attend the change from liquid to solid of pure polar materials at the melting point.

Measurements have been carried out on two typical polar materials, stearic acid and cetyl palmitate, and for comparison purposes on a relatively non-polar material, paraffin wax. These were spread in thin films, about 1 mm. thick, on a polished platinum plate kindly supplied by the Mond



A, Paraffin wax, m.p. 60° C. *B*, Stearic acid, m.p. 65° C. *C*, Cetyl palmitate, m.p. 48° C.

Nickel Co. The potentials were measured by the usual method employed for following surface potential changes on unimolecular films spread on water, using a valve electrometer and a radioactive (polonium) electrode[1]. The accompanying figure shows the potential in millivolts as a function of temperature for the three materials. It is significant that the two polar materials exhibit an abrupt change at the melting point (within the experimental error) while the non-polar paraffin wax exhibits no abrupt change at the melting point. The recorded potentials are, of course, not absolute values since they involve various contact potentials inherent in the apparatus. The potentials recorded are the sum of these various contact potentials and the potentials arising at the boundary metal/film and film/air. Only the two latter sources of potential might be expected to show discontinuities at the melting points in the case of polar materials, since the passage from the liquid to the solid state will involve changes in molecular orientation.

The exact source of these potentials is not clear, but changes in orientation of polar molecules at phase boundaries might be expected to play a part, and the absence of any abrupt change in the case of the non-polar paraffin wax appears to be significant in this respect.

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A Magnetic Study of the Effect of Bond Angle Distortion

The prediction[1] that diamagnetic nickel complexes would prove to be square co-ordinated has been verified in a number of different ways. The discovery of isomeric nickel glyoximes[2], the crystal structure of potassium nickel dithioxalate[3] and investigations of crystal optics[4] and isomorphism[5] of other diamagnetic nickel compounds have all borne out the existence of this correlation between structure and magnetic properties. All internal nickel complexes in which four nitrogen atoms are bonded to the metal atom have proved, on investigation, to be diamagnetic, and they may therefore be presumed to be square bonded. The nickel derivatives of various glyoximes[2], phthalocyanine[6] and protoporphyrin[7] afford examples of this type of complex. In these circumstances it becomes possible to investigate magnetically the question as to whether distortion from a square configuration gives nickel-nitrogen bonds sufficient ionic character to make a complex paramagnetic.

Porter[8] has shown that when certain substituted pyrromethenes (with methyl groups in the α position) function as chelate groups and attempt to assume a planar configuration, as with nickel, clashing between methyl groups must occur. In a complex containing two pyrromethene molecules attached to a single nickel atom, the Ni-N bonds must be forced from their normal coplanar disposition. This occurs in nickel *bis* ethyl 3 : 3′–5 : 5′-tetramethyl-pyrromethene-4 : 4′ dicarboxylate, the compound chosen for investigation. Susceptibility measurements show that the compound is paramagnetic and that the nickel atom has a magnetic moment of 3·2 Bohr magnetons. From this it may be inferred that forcing the Ni-N bonds out of the plane profoundly alters their character; they are no longer essentially covalent bonds involving the use of dsp^2 orbitals but are predominantly ionic in character.

Further details of this work will be published shortly. We are indebted to Dr. R. Lemberg for providing facilities for carrying out this and related work.

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History of the Vacuum Flask

Lord Rayleigh states in Nature of April 20 that Dewar's assistant, Lennox, made the first vacuum flask. As one of the few survivors directly concerned with the production of the vacuum flask from its inception, I wish to place on record the facts as I know them.

I first met C. E. Muller, the expert glassblower, in 1887 at 147 Gower Street, where he lived with his brother, Emelius, who was established there as "Artificial Human Eye Maker". At that time I had a laboratory in Charlotte Street, Fitzroy Square, W., for which Muller made the chemical apparatus. At my suggestion Muller began business, in 1887, at 26 Charlotte Street, moving to next door (28) in 1888. In 1891 he removed to 148 High Holborn, the lease of which I helped him to negotiate, where he continued in business until about 1910, with such success that he was able to retire.

From 1887 until about 1900, when a Mr. Orme joined him as partner, I was on intimate terms with him in the conduct of his business. When Dewar in 1892 asked Muller to make for him the first double-walled vacuum vessels, they were all made of clear glass, which is sufficient proof, I think, that they were the earliest made. It was then suggested that the internal surface should be silvered, to reduce radiation influx; as Muller had no experience in this, I instructed him in the technique, and actually silvered the first two or three vessels myself.

The fact that Lord Rayleigh was unaware that Muller was in London at this time suggests to me that it must have been a considerable time after 1892 when Lennox demonstrated to him how double-wall vacuum vessels were made. By this time Lennox may have learned the technique of making them from Muller, as these vessels are very difficult to make, and no ordinary glassblower, *at that time*, would be capable of doing so.

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Economy in Education

THERE is one way in which a great many of our public schools might well economize, and that is in the building and equipment of science laboratories such as are in use at the present time. My teaching experience is confined to public schools only; but I give it as my opinion that the money spent on costly apparatus and equipment is in many cases sheer waste and out of all proportion with the science which can and should be taught in schools.

I do not stand alone in this matter, for Mr. O. H. Latter, probably the pioneer of the teaching of biology in schools, writes in the preface of "Readable School Biology" (Bell, 1926): "I hold that with classes taking Biology as a part of their *general education*, personal practical work by the pupils themselves is sheer waste of time and money".

Much of the responsibility for this waste lies at the door of the science teachers themselves, but I think that still more lies at the door of the Board of Education.

A. G. LOWNDES.

Plymouth.
May 12.

Points from Foregoing Letters

P. J. G. Mann and J. H. Quastel show that the addition of vitamin B_1 to isolated polyneuritic pigeon brain increases the rate of synthesis of acetylcholine when the brain is incubated aerobically in a bicarbonate – pyruvate medium containing a relatively high concentration of potassium ions. No such increase occurs when the vitamin is added to normal pigeon brain examined under similar conditions.

By successive digestion with pepsin and trypsin, an enzyme-resistant phosphopeptone of constant composition has been isolated by M. Damodaran and B. V. Ramachandran from casein in the form of its barium salt. In contrast to a similar phosphopeptone obtained by Rimington, which was claimed to contain hydroxyglutamic acid, hydroxyaminobutyric acid and serine, the substance isolated consists of glutamic acid, *iso*leucine and serine.

Normal adult and embryonic tissues explanted *in vitro* begin to proliferate after a certain latent period which varies with the age of the organism. L. Doljanski and R. S. Hoffman have investigated the latent period of neoplastic tissue (rat sarcoma and Rous chicken sarcoma) and found that tumour explants commence proliferating *in vitro* after a latent period which is very much shorter than that of normal adult tissue. In about half the experiments tumour tissue started to grow practically without [illegible] latent period.

H. Loewenthal and F. L. Hopwood find that fully capsulated young cultures of hæmolytic streptococci, when exposed to ultrasonic vibrations, provide a better antigen than overnight cultures. They point out, however, that since the disintegration of streptococci by ultrasonic vibrations liberates serologically active material from cocci possessing no demonstrable capsule as well as from the fully capsulated cocci, the observations cannot be taken as conclusive proof that the type-specific antigen of streptococci is situated only in the capsule.

Three skulls of very young individuals of the Indian antelope (*Antilope cervicapra*) showed the presence of rudimentary upper canine teeth, which in one case had not reached the surface of the maxilla. J. Ritchie suggests that this evidence supports Forsyth Major's belief that rudimentary canine teeth may be present in all fœtal and most very young antelopes, notwithstanding the evidence recently adduced by Lönnberg.

R. S. Krishnan and T. E. Banks have separated chemically the recoil fragments produced from uranium fission under deuteron bombardment and have shown that some of the activities agree with those produced by neutron fission of uranium. They have also obtained evidence of deuteron-induced fission in thorium. Excitation function measurements and chemical separation of the recoil fragments have been carried out for this case also.

The effect of temperature in the ultra-violet transparency of various glasses has been examined in detail by W. J. Arrol for two wave-lengths close to the limits of transparency in this region. A strictly linear relation holds between absorption coefficient and temperature over the range 10°–50° C.

Measurements of phase boundary potential during the melting of certain solids by C. Ockrent and W. H. Banks show that the transformation is accompanied by abrupt changes in potential.

D. P. Mellor and W. H. Lockwood have measured the magnetic susceptibility of a nickel compound in which the normal planar distribution of the bonds about the nickel atom is prevented by steric interference. They claim that the distortion changes the character of the bonds from being essentially covalent to bonds essentially ionic in character.

RESEARCH ITEMS

New Shrines on the Gold Coast

A RELIGIOUS development, which is in effect a reversion to a traditional form of belief, now taking place on the Gold Coast is described by Miss M. J. Field, Government anthropologist (*Africa*, 13, 2; 1940). In the traditional society of the Gold Coast, which still survives in certain isolated areas, the governmental unit was the extended family with the head as both ruler and priest of the family god. So also in the confederated family groups, still existing, religious organization and governmental organization are one. In other parts of the Gold Coast, for example, Akim, this traditional form has been overthrown. From the end of the seventeenth century, colonists and refugees set up a military organization which has now, with the development of the cocoa industry, become financial. The earlier cults completely disappeared. Recent social changes, more especially a great increase in venereal disease, detrimental to fertility, and marital infidelity among the women, have led to a remarkable increase in belief in the power of the witch. New protectors against this malevolent force have been sought in the Northern Territories, where there is no witchcraft, because of the power of the traditional indigenous deities. Their worship has therefore been introduced into the Gold Coast country as a protective magic, subordinate shrines being set up. All over Akim these shrines have been instituted, and some have gained a far-flung reputation. It is suggested that the prevalence of these shrines indicates a reversion to a type of organization similar to that which was broken up by intrusions two hundred years ago.

Radium and Radon Therapy

A SECOND edition of "Physical Aspects of Radium and Radon Therapy", published in May, 1939, by the Ministry of Health of the Commonwealth of Australia, goes over some ground that is already familiar; but there are several new features, notably those on the technique of radon filling and on the comparative advantages of radium and radon considered from economic and technical points of view. There is also an interesting attempt to distinguish between the total dose of radiation given to the tissues and the effective dose that results; the difference only arises because of the power of the tissues to recover from the effects of radiation while it is actually being given. The authors, C. E. Eddy and T. H. Oddie, develop this matter on simple mathematical lines, but in lieu of experimental data have to proceed as follows: "Now suppose that a dose of gamma rays delivered at any given instant decays in its effect on the tissues by x per cent in 24 hours. . . ." Granted the assumptions, the following conclusions are reached: "(*a*) The quantity of radon required to give the tissues the same residual dose R′ in any given time as is given by one milligram of radium, is slightly greater than that required to deliver the same dose R. (*b*) When radon is used the residual dose R′ is higher for a longer period of time than is the case when radium is used."

Cytology of Carcinogenesis

DR. PULLINGER (*J. Path. Bact.*, 50; 1940) has studied the early stages of tumour formation by polycyclic compounds. The carcinogenic compounds evoke a characteristic reaction on the second to fourth day after application; the cells and nuclei swell and the cytoplasm becomes vacuolated. This reaction is followed by multiplication of cells with progressive increase in size of cells and nuclei. Cytoplasmic degeneration appears in some of the cells while others show signs of recovery. Related non-carcinogenic compounds do not appear to produce this reaction, which may be specific.

Curious Nesting-place of Kittiwake

EVENTS in Norway have made the March number of *Naturen* the last we are likely to receive for some time to come, for the spreading of scientific news in popular form among Norwegian naturalists must give way to more vital affairs. Along with articles dealing with such varied subjects as the newer geophysical methods of assessing the underlying rock formations, and the occurrence of the jelly-fish *Rhizostoma octopus* in Norwegian waters in the Atlantic Drift, occurs an interesting account of a modification of nesting-place in the kittiwake. Instead of the usual sites chosen on the narrow ledges of sea-cliffs, Knut Schmidt-Nielsen describes how in 1928 kittiwakes (*Rissa tridactyla*) began to prospect the ledges of a wooden brewery at Røst, and how by the summer of 1939 twenty-one pairs were nesting in regular rows where suitable shelves were present on the building. The selection of so curious a site is the more remarkable because it was in close proximity to a constant stream of traffic, boats and motor-boats (*Naturen*, Bergen, 94, March 1940). An excellent photograph shows about fifteen of the nests, most of them occupied.

Stratification of Foraminifera in Marine Deposits

H. G. STUBBINGS has examined six cores obtained by the John Murray Expedition in the Southern Arabian Sea (John Murray Expedition 1933–34. *Sci. Rep.*, 3, No. 3. "Stratification of Biological Remains in Marine Deposits". British Museum (Natural History), 1939). Only the Foraminifera are described in this report, the object being to demonstrate 'climatic' classification in the Arabian Sea similar to the findings of previous workers in the Atlantic. Many pelagic species occurred and a few benthic species. Of the pelagic species *Globigerina bulloides* and *Globorotalia menardii* are the commonest, and occur in inverse relationship. *Globigeri*[illegible] *bulloides* is mainly a cold-water species and *G*[illegible]*orotalia menardii* is an inhabitant of tropical and subtropical waters. It has thus been found possible to use these two species as a guide to changes of climatic conditions in the past. Four 'cold zones' are shown in the longest core, containing *Globigerina bulloides* in quantity, and the intermediate zones with relatively more *Globorotalia menardii* probably represent warmer interglacial periods.

Inheritance of Instinct

VERY young setters will instinctively 'point'; Siamese cats are natural retrievers, a character which is known to be dominant in cats; the wooler rabbit jumps in the air and shaker mice turn somersaults when frightened. C. E. Keeler and H. C. Trimble (*J. Hered.*, 31, 51–54; 1940) describe pedigrees of Dalmatian hounds which indicate that the position under or behind the coach automatically taken by the dog is controlled by heredity. Several interesting examples of instinctive reactions in untrained animals are given. 24 good following dogs and 3 poor followers descended from parents both of which were good coaching dogs. On the other hand, the crosses bad × good and bad × bad produced 7 good, 9 bad and 2 bad dogs respectively. One bitch which always ran with her head between the horse's legs was mated to a dog that trailed behind the carriage. The three pups trailed badly. The same bitch was mated to a dog which ran forward of the front axle. Of their resulting progeny, 6 pups ran in the forward position, and one insisted on running with his nose touching the horse's hind legs (see also NATURE, 144, 671; 1939).

Chromosome Numbers of British Plants

IN connexion with the recent co-operative work in taxonomy, genetics, and cytology, P. Maude (*New Phyt.*, 39, 17–32; 1940) has investigated the chromosome number of numerous British wild plants. Such plants as *Chenopodium album, Arum maculatum, Allium Babingtonii, Corydalis bulbosa, Sieglinga decumbens* ($2n = 124$), *Kœleria vallesiora, K. gracilis* ($2n = 28$ and 30), *Puccinellia* (*Glyceria*) *maritima* ($2n = 63$), various species of Festuca and Bromus and other plants were found to be polyploid. A curious feature was that seven plants of *Spirea filipendula* ($2n = 15$) from different sources had an odd number of chromosomes.

Cryolite as an Insecticide

FLUORINE compounds have so far proved the most effective substitutes for arsenical insecticides. Sodium fluosilicate, a by-product in the manufacture of acid phosphate, is being used extensively in the United States for baits in the control of grasshoppers and cutworms. Cryolite, a compound of sodium, aluminium and fluorine mined in Greenland, is very effective against fruit pests such as codling moth and apple flea weevil and for vegetable pests such as flea beetles. S. Marcovitch writes (*Amer. Fruit-grower*, Feb. 1940) on the use of cryolite in apple orchards. The mineral, which is used mainly in the manufacture of aluminium, is ground to a fine dust occupying about 50 cub. in. to the pound. Like lead arsenate, it acts as a stomach poison but is more effective than the former against codling moth. It has less sticking power, however, and is therefore most effective in dry seasons. It has no poisonous effect on the soil, a great advantage over arsenical compounds, which have rendered some soils in America unfit for crops. Another advantage is that [illegible] is non-poisonous in the amount likely to remain [illegible] spray deposit on apples. The amount allowed by law is 0·02 grain per lb. Fluorides present in drinking water to the extent of 1 part per million cause mottling of the teeth of residents in some parts of Arizona. Cryolite on apples has been shown to be free from this objection. In contrast to lead arsenate, cryolite appears to have no injurious effect on apple foliage. As many as seven applications in a season have been given without causing defoliation or damage to fruit. In some seasons, however, damage to peach fruits known as 'tip end injury' has occurred.

Irradiation of 7-Dehydrocholesterol

STEROLS which have received most attention in respect of photochemical conversion into antirachitics are ergosterol and cholesterol, associated with lower plants and with animal materials, respectively. Crystalline ergosterol may be regarded as the precursor of vitamin D_2 (calciferol); crystalline cholesterol does not itself constitute a significant provitamin but its derivative, 7-dehydrocholesterol, when exposed to ultra-violet radiation, is converted into vitamin D_3, found only in animal tissues. J. W. M. Bunker, R. S. Harris and L. M. Mosher (*J. Amer. Chem. Soc.*, 62, 508; 1940) have examined the photochemical activation of crystalline 7-dehydrocholesterol in ether by monochromatic ultraviolet radiation. With wave-lengths 2483, 2537, 2652, 2804 and 3025 A., the activation is substantially uniform per quantum of energy supplied. On a quantum basis, the activation by 2967 A. is significantly greater than for any other wave-length examined, except possibly 2894 A. The activation by 2894 A. appears to be intermediate between that of 2967 A. and the other wave-lengths examined. No demonstrable antirachitic properties were produced by 3130 A. The superior effectiveness of 2967 A. parallels the significant superiority of this wave-length in inducing healing upon direct irradiation of depilated rachitic rats, which supports the view that 7-dehydrocholesterol is a significant precursor of vitamin D in the skin.

Spectrophotometric Gradients of some Northern Stars

AN important paper entitled "Relative Gradients of 250 Stars determined at the Royal Observatory, Greenwich" has been published by H. Spencer Jones (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940). The catalogue of the spectrophotometric gradients of the 250 stars includes most northern stars brighter than 4·5, the H.D. spectral types of which are *Oe5*, *B* or *A*, as well as many fainter ones of these types and a selection of bright *F*- and *G*-type stars, and completes the Greenwich colour temperature programme. The previous results were given in "Observations of Colour Temperatures of Stars", 1926–32, and a description was given in this volume of the methods used in determining the gradients. These differ very slightly from those adopted in the later programme. The 30-inch reflecting telescope has been replaced by the 36-inch Yapp reflector, and in the case of fainter stars small corrections have been applied to allow of the difference in exposure time between the stellar and the calibration exposure. More sensitive Ilford 'Astra VIII' plates have been utilized in the later work, and it is hoped that full details of the scheme will appear later in a Greenwich volume which is delayed in publication owing to the War. As a definite value of the quantity needed to convert absolute to relative gradients is not yet available, relative gradients only are given in the catalogue. In the previous work the zero to which the gradients were referred was the mean of nine specified stars of H.D. type *A*0, and it is thought that the value for the Greenwich zero-point may be about 1·10, which corresponds to 15,600° K., but this will be determined later. The absolute values of the gradients and hence of the 'temperatures' will be obtained when the Greenwich zero-point is finally settled.

MUCOLYTIC EFFECT OF NATURAL AND ARTIFICIAL SPREADING FACTORS

MUCOLYTIC EFFECT OF SEVERAL DIFFUSING AGENTS AND OF A DIAZOTIZED COMPOUND

By PROF. G. FAVILLI, University of Modena

CHAIN and Duthie[1] have recently reported that a purified testis extract, which contains the so-called 'spreading factor' that increases the permeability of the tissues, has a remarkable mucolytic activity: the viscosity of synovial fluid falls very rapidly when it is mixed with a tenth of its volume of the extract. The loss of viscosity is followed by liberation of N-acetyl glucosamine and reducing substances. Bacterial filtrates in which the spreading factor is present were found to have a similar action on mucin. These observations suggest that the diffusing and mucolytic activities may be due to the same factor, and it is of interest therefore to determine whether diffusing factors from other sources show a similar mucolytic effect. The solutions to be tested have been added to fresh bovine synovial fluid in a proportion of one to ten volumes and the mixtures incubated at 38° C. The following facts have been observed.

Snake venoms, which possess a very high diffusing activity[2,3], show a marked mucolytic effect. Venoms from the following species have been tested: *Vipera aspis*, *Vipera ammodytes*, *Bothrops jararaca* (former name: *Lachesis lanceolatus*), *Lachesis alternatus*, *Echis carinatus*, *Crotalus terrificus*. The dried venoms, dissolved in saline solution, cause a rapid fall in the viscosity of synovial fluid, measured in an Ostwald viscometer. The fall of viscosity may be almost immediate when venoms are used in dilutions varying from 1 : 1000 to 1 : 10,000, according to the species of snake. This effect was evident in dilutions as high as 1 : 100,000.

The mucolytic activity is almost completely suppressed when the solution of venom is heated for thirty minutes at 70° C. before it is added to the synovial fluid. The activity of the enzyme is also completely suppressed when specific antiserum in a convenient amount is added to the solution of venom: the addition of normal horse serum, on the contrary, has no inhibitory action.

Aqueous leech extracts which, as Claude[4] reported, show marked diffusion in the dermis, proved to be actively mucolytic. An aqueous extract of the heads of several leeches was prepared by grinding this material with quartz sand in a mortar and adding saline solution in an amount equivalent to 1 c.c. per head. After centrifugation, the supernatant fluid was mixed with synovial fluid, the viscosity of which fell to a value not much higher than the viscosity of water after a short incubation.

The *p*H appears to have a great influence on the mucolytic action; experiments have been made with testis extract, purified by the method described by Mannozzi-Torini[5], and snake venoms prepared with buffer solutions of different *p*H value instead of saline. It has been observed that testis extract and snake venoms are most active at about *p*H 5·0; the activity gradually decreases and can be practically inhibited, at least in the case of snake venoms, when the *p*H is adjusted to 8·5. These results are in agreement with those of McClean[6].

Commercial preparations of Frey and Kraut's *kallikrein* (Padutin Bayer) have a certain diffusing activity[7] which appears to differ in character from that of the other spreading factors so far known[7,8]: no mucolytic effect could be detected with this substance. The observations reported above, taken in conjunction with those of Chain and Duthie, indicate that all the naturally occurring diffusing factors so far tested possess mucolytic activity.

As Chain and Duthie point out, the action of diffusing factors may be explained by the presence of a mucin-like inter-fibrillar substance in the collagen of the dermis in which these factors are active[9]. In order to support this hypothesis it seemed desirable to ascertain whether certain artificial compounds possessing diffusing power have the same mucolytic effect as the naturally occurring diffusing factors.

Following the instructions given by Claude[10], who first observed the diffusing properties of an azoprotein obtained by coupling diazobenzenesulphonic acid with serum or gelatin, this compound has been prepared and coupled with horse serum. The reaction of the azoprotein was adjusted as nearly as possible to *p*H 7·0 by the addition of normal acetic acid, this operation being controlled electrometrically; it was then buffered by adding 2 c.c. of phosphate buffer at *p*H 7 to 4 c.c. of azoprotein. The final solution possesses marked mucolytic activity, when tested on synovial fluid. The fall of viscosity is not abrupt; it is most marked in the first hour, and continues gradually until the fourth hour, as is shown in the following experiment.

FALL OF VISCOSITY, EXPRESSED IN TIME OF FLOW THROUGH A VISCOMETER IN SAMPLES OF 3 C.C. TAKEN AT DIFFERENT INTERVALS FROM 30 C.C. OF SYNOVIAL FLUID INCUBATED AT 37° WITH 3 C.C. OF AZOPROTEIN BUFFERED AT *p*H 7·0

Distilled water	7 min.	5 sec
Normal synovial fluid added with 1/10 vol. of distilled water	27 ,,	5 ,,
Synovial fluid added with 1/10 volume of azoprotein: immediately	26 ,,	
Synovial fluid added with 1/10 volume of azoprotein after 15 min.	20 ,,	
,, ,, ,, ,, ,, ,, ,, 30 ,,	17 ,,	5 ,,
,, ,, ,, ,, ,, ,, ,, 45 ,,	15 ,,	5 ,,
,, ,, ,, ,, ,, ,, ,, 60 ,,	13 ,,	5 ,,
,, ,, ,, ,, ,, ,, ,, 90 ,,	12 ,,	
,, ,, ,, ,, ,, ,, ,, 120 ,,	11 ,,	5 ,,
,, ,, ,, ,, ,, ,, ,, 180 ,,	10 ,,	5 ,,
,, ,, ,, ,, ,, ,, ,, 240 ,,	10 ,,	

Comparative experiments made with azoprotein and with naturally occurring diffusing factors have shown that the mucolytic effect of the latter is much quicker than that of the former substance, the fall in viscosity being complete after thirty minutes if the diffusing factors are sufficiently concentrate[illegible] (for example, *Vipera aspis* venom diluted 1 : 10[illegible] This result accords with the fact that the diffusion of naturally occurring factors, when tested in the dermis of the rabbit, is much more rapid than the diffusion of azoproteins; this might, therefore, be considered as indirect support for the hypothesis that diffusing factors act by destroying the mucin-like inter-fibrillar substance.

In several experiments the diazobenzenesulphonic acid was neutralized, immediately after its preparation, with $2N$.NaOH solution, buffered with phosphate buffer at pH 7, and tested on synovial fluid: the mucolytic activity of this compound is practically the same as that of the acid coupled with serum.

The mucolytic effect of the diazobenzenesulphonic acid, both in the form of azoprotein or of sodium diazobenzenesulphonate, is little influenced by the pH: the maximum activity has been observed at a pH of about 5·0, the minimum at pH 7·0, whereas there is a slight increase of activity at pH 8·5. This fact needs further investigation.

These results indicate that both the artificial and naturally occurring diffusing factors so far tested exhibit similar mucolytic activity, and support the hypothesis that the action on tissue permeability may be due to enzyme activity on the mucin-like interfibrillar substance.

Some difficulties have been encountered in attempting to decide whether the chemical action of diffusing factors on mucin, as measured by the liberation of reducing substances, is identical whatever the source of the factor. This point is of special interest in the study of the action of diazotized compounds, and the experimental difficulties encountered are under investigation.

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MUCINASE AND TISSUE PERMEABILITY

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AQUEOUS extracts of mammalian testis contain a 'spreading' factor which dramatically increases the permeability of the skin to injected fluids[1]. This factor is associated with the germinal epithelium and can be extracted from spermatozoa. Factors with similar diffusing properties have been obtained from the most diverse sources, for example, from filtrates of staphylococcus and streptococcus[2], from organisms of the gas gangrene group and virulent pneumococci[3], from extracts of malignant tissues[4], from snake and spider venoms[5] and from leech extracts[6]. Many of these factors have been partially purified by various methods[7], but no one had succeeded in elucidating the mechanism whereby this diffusing effect is produced until Chain and Duthie[8] made the important observation that purified testis extracts exhibit a remarkable mucolytic activity characterized by a rapid fall in the viscosity of the substrate and the liberation of reducing substances.

It was obviously important to confirm the observation of Chain and Duthie, to determine whether diffusing factors from other sources exhibited a similar mucolytic activity and to make a comparative study of these enzymes. During the progress of this work, Meyer *et al.*[9] reported the hydrolysis of hyaluronic acid by bacterial enzymes, and recently a paper appeared by Robertson *et al.*[10] describing an enzyme derived from filtrates of *Cl. welchii* which hydrolyses synovial fluid; these authors had not connected the mucolytic activity of their preparations with the action on the permeability of the tissues.

In our earlier experiments vitreous humour was used as substrate, but in view of its spontaneous loss of viscosity on storage this was replaced by preparations of mucoprotein from umbilical cords; this can be purified by the method described by Meyer and Palmer[11]. Viscosity estimations were performed with buffered solutions of standard salt concentration in an Ostwald viscometer in a water bath at 34° C. N-acetyl glucosamine was estimated by the method of Morgan and Elson[12], and total reducing substances by the method of Hagedon and Jensen. Diffusing activity in the skin was estimated by intracutaneous injection using isotonic hæmoglobin solution as the indicator of spread.

We have confirmed the mucolytic activity of testis extract reported by Chain and Duthie; preparations of the diffusing factor purified by the method of Morgan and McClean and by those of Madinaveitia show similar activity. Purified preparations of the diffusing factor from *Cl. welchii* and *Cl. œdematis maligni* (*Vibrion septique*) are extremely active. Filtrates from a toxigenic strain of staphylococcus and from a virulent type 1 pneumococcus showed activity of the same order. All these organisms produce immediate diffusion in the dermis. On the other hand, filtrates from a virulent strain of *S. typhi*, from *Cl. tetani* and from *C. diphtheriæ* which produce no diffusion also contain no mucinase. The activity of the filtrate from virulent type 1 pneumococci is of interest since one of us[3] has reported that the same strain rendered avirulent by cultivation in immune serum loses its diffusing power; on the other hand Meyer *et al.* obtained their enzyme in the autolysate of a "non-encapsulated non-type-specific variant" of a type 2 strain and drew a distinction between their pneumococcal enzyme which was bound to the cell structure and that of *Cl. welchii* which was free in the fluid medium.

Russell's viper venom, which diffuses in the dermis, causes a rapid fall in the viscosity of mucoprotein. Since this venom promotes the coagulation of hæmophilic blood, and the chemical constitution of heparin is closely allied to that of muco-polysaccharide, it was of interest to determine whether this venom and the mucinases from testis or from bacteria exerted any destructive effect on heparin. So far as we have been able to determine by indirect experiments using the coagulation time of heparinized plasma as an indicator of the integrity of the heparin molecule, none of these substances has any direct action on heparin. This confirms the observation of Meyer *et al.* that their bacterial enzymes do not hydrolyse heparin.

The enzymes obtained from testis extract, from all the bacterial enzymes so far tested and from viper venom are most active at about pH 4·5. The rate of the reaction decreases sharply on the acid side of this and more gradually as the pH approaches neutrality.

The mucolytic activity of the bacterial enzymes is completely inhibited by appropriate antisera. Sera had been prepared against the purified diffusing factors of *Cl. welchii* and *Vibrion septique*. It has already been shown[3] that such sera neutralize the diffusing activity in the dermis and that the immunized animals are themselves resistant to the diffusing activity. This neutralization is strictly specific. We have now been able to establish that these sera completely inhibit the action of the homologous enzyme on the viscosity of the substrate and the liberation of reducing substances; there is no cross neutralization of this activity.

It is of considerable interest that, although these enzymes cause an immediate fall in the viscosity of the substrate, no reducing substances can be detected for some hours. With a preparation of the diffusing factor of *Cl. welchii*, which causes a marked fall in viscosity in a few minutes, only a trace of N-acetyl glucosamine can be detected after four hours and the maximum is not attained until after 18–24 hours incubation. At first it was thought that enzymes from different natural sources differed qualitatively as well as quantitatively in their capacity to liberate reducing substances; when, however, the concentration of enzymes from testis, *Cl. welchii* and viper venom was adjusted so that the reaction times for the reduction of viscosity were comparable, it was found that the amount of enzyme necessary to liberate detectable reducing substances was approximately the same whatever the source. The time lag in the liberation of reducing substances compared with the fall in viscosity suggests that two separate mechanisms may be involved. This possibility requires further study.

We have confirmed Favilli's observation, reported above, that diazotized compounds reduce the viscosity of mucin. We have encountered the same difficulties as he has in deciding whether N-acetyl glucosamine or other reducing substances are liberated by these preparations. These difficulties arise from the coloured nature of the diazotized compounds and the difficulty of removing the soluble protein. Preliminary experiments to overcome these difficulties indicate that no reducing substances are liberated, but these observations require confirmation.

Robertson *et al.*[10] state that the spontaneous loss of viscosity of vitreous humour is due to the activity of vitamin C. We have examined the diffusing and mucolytic activities of ascorbic acid in freshly boiled buffer at *p*H 7·0 and with the addition of one and two molecular equivalents of hydrogen peroxide. All three preparations cause a rapid fall in the viscosity of the substrate, the activity of the preparation with one equivalent of hydrogen peroxide being slightly greater than either of the others. No N-acetyl glucosamine could be detected following the fall in viscosity. The increased diffusion in the dermis following the injection of these substances is marked, but it is of the same type as that caused by diazotized compounds; that is, the increase is not apparent in the first few minutes but develops during a period of three hours. The preparation with one equivalent of hydrogen peroxide spreads over a greater area than either of the others. Thus the mucolytic activity of ascorbic acid and its oxidation products is also associated with an increased diffusion in the dermis.

An explanation of the physiological function of the mucinase in testis extract and spermatozoa is provided by the observation of Kurzrok and Miller[13] that semen contains a mucolytic enzyme whereby the spermatozoa are enabled to penetrate the plug of mucus normally present in the cervical canal of the uterus. The part played by bacterial mucinase in the metabolism of these organisms in artificial culture and on their invasive properties in the tissues is under investigation.

[1] Hoffmann and Duran-Reynals, *J. Exp. Med.*, **53**, 387 (1931); McClean, *J. Path. and Bact.*, **33**, 1045 (1930); **34**, 459 (1931).

[2] Duran-Reynals, *J. Exp. Med.*, **58**, 161 (1933).

[3] McClean, *J. Path. and Bact.*, **42**, 477 (1936).

[4] Duran-Reynals and Stewart, *Amer. J. Cancer*, **15**, 2790 (1931); Boyland and McClean, *J. Path. and Bact.*, **41**, 553 (1935).

[5] Duran-Reynals, *J. Exp. Med.*, **69**, 69 (1939).

[6] Claude, *J. Exp. Med.*, **66**, 353 (1937).

[7] Morgan and McClean, *J. Soc. Chem. Ind.*, **51**, 44, 912 (1932); Claude and Duran-Reynals, *J. Exp. Med.*, **65**, 661 (1937); Madinaveitia, *Biochem. J.*, **32**, 1806 (1938); **33**, 347 (1939); **33**, 1470 (1939).

[8] Chain and Duthie, NATURE, **144**, 977 (1939).

[9] Meyer, Hobby, Chaffee and Dawson, *J. Exp. Med.*, **71**, 137 (1940).

[10] Robertson, Ropes and Bauer, *J. Biol. Chem.*, **133**, 261 (1940).

[11] Meyer and Palmer, *J. Biol. Chem.*, **114**, 689 (1936).

[12] Morgan and Elson, *Biochem. J.*, **28**, 988 (1934).

[13] Kurzrok and Miller, *Amer. J. Obstet. and Gynæc.*, **15** 56 (1928); **24**, 19 (1932).

APPLICATIONS OF ELECTRICITY IN IRON AND STEEL WORKS

A REVIEW by H. G. Weaver of the progress made in the applications of electricity in iron and steel works during the last four years appears in the March issue of the *Journal of the Institution of Electrical Engineers*.

It appears to be now admitted that whereas Ward-Leonard control affords the most efficient method of providing the drive for the hoist and long-travel motions, the additional weight involved in the carrying of the conversion set on the crab is considered to outweigh its advantages, and a plain direct-current series drive has proved the most popular, the motors being of the steel-clad mill pattern, with roller bearings and split frames.

The main point of interest with recent installations of drives for coal-handling plant is the universal adoption of totally enclosed, fan-cooled motors. The controls have a system of sequence interlocking, which ensures that the stopping of certain conveyors will always automatically ensure the stopping of any other conveyors that are feeding them. More attention has recently been paid to the enclosure of the motors used in these plants, owing to the deleterious effect of the gases in the atmosphere. Special castings are used so far as possible, care being taken to see that they are free from porosity. Gas-proof gaskets and varnish are used for all frame and cover joints, and the windings carefully sealed with varnish and given extra coats of enamel.

In modern practice, the electrical equipment of blast furnace skip hoists is of the balanced type with two hoist motors on each. The weight of each basket empty is 12,000 lb., and the weight of each ore charge is 18,000–20,000 lb. The skip travel is 200 ft., at a speed of 450–600 ft./min. with an angle of incline of 53° from the horizontal. Each hoist is driven by two 200 h.p., 220 volt, direct-current, steel-works type motors, with a speed range of 0 to 570–762 r.p.m., by shunt control, which are forced ventilated by motor-driven blowers, mounted on the top of the motor frame. The two motors are connected in series across a 310 kw., 440-volt generator. The two skip hoists are arranged by switching to run from any two of three motor-generator sets, each set comprising a 310 kw., 440-volt generator driven by a 450 h.p., 3-phase, slip-ring induction motor.

New features are continually being introduced in the electrical operation of the winch equipment for the charging bells of blast furnaces. In a recent example, the large bell is driven by a 17 h.p., D.C., compound wound motor, and the small bell by a 10 h.p. motor of the same type and speed. In each case the motor speed when raising the bell is 540 r.p.m., and when lowering the bell 840 r.p.m. The control is by contactors and resistances, and is so arranged that in the event of slack cable, the bell-lowering contactors are opened and the winch is automatically reversed, so taking up the slack cable; then after a short time interval the bell is automatically caused to lower again, and this operation is repeated until the bell falls away freely or the operation is tripped by hand. There is also complete interlocking of the bells so that one bell must have completed its full travel and also sealed before the other bell moves.

The production of iron in a modern blast furnace is a continuous process, and the main essential of furnace operation is therefore smooth and regular working, with as few stops as possible. The most difficult problem has been the development of a satisfactory method of stopping up the iron tapping hole when required without the necessity of shutting off the blast. An electrically driven clay gun has recently been introduced for this purpose. The gun itself is suspended from a boom, which swings it into position and holds it against the hole while plugging is taking place. The gun is driven by a 20 h.p. motor and the boom by a 10 h.p. motor. They are switched direct on to the line without any overload or other type of protection, but limit switches are provided on both motions to prevent mechanical damage due to mal-operation of the controllers. The stalling torque of the 20 h.p. motor is 1·6 times full load torque and of the 10 h.p. 1·35 times full load torque, in each case when taking 2·5 times full load current at full line voltage. The boom motor is stalled when holding the gun against the hole. Very high ambient temperatures are encountered, and the motors have to be capable of withstanding stalling for half a minute under these conditions without excessive heating. They have 3 per cent nickel-steel shafts running in ball and roller bearings and are of welded steel construction throughout. The rotor windings consist of bronze bars secured in semi-enclosed slots, which are lined with anodized aluminium.

One plant for producing aluminium sheets has been equipped with a soaking pit furnace for ingots, a chain-conveyor furnace for slabs, cylindrical pit-furnaces for coil annealing and salt-bath furnaces for the heat treatment of sheets, all electrically heated and capable of dealing with aluminium. A particularly interesting development which is gaining ground more and more is the nitriding process, that is, the treatment of steel in an ammonia atmosphere, for the production of specially hardened parts.

SEVENTY YEARS AGO

NATURE, vol. 2, June 2, 1870

Effects of Alcohol on the Human Body

A PAPER was read before the Royal Society on May 19 "On the Effects of Alcohol (*Ethyl Alcohol*) on the Human Body", by Dr. Parkes and Count Cyprian Wollowicz. The experiments were undertaken with a view of testing the physiological and especially the dietetic effects of alcohol. The subject was a healthy and very intelligent soldier of twenty-eight, 5 ft. 6 in. in height, weighing 134–136 lb., with a clean, smooth skin, a clear bright eye, good teeth, largely developed powerful muscles, and but little fat. As he had been accustomed to smoke, he was allowed half an ounce of tobacco daily, lest the deprivation of it might disturb his health.

From the general results of the experiments, it appears that any quantity over 2 oz. of absolute alcohol would certainly do harm to this man, and that as every function was performed perfectly without it, its use was wholly unnecessary. Yet the experimenters recognize "the great practical benefit that may be derived from the use of alcohol in rousing a failing appetite, exciting a feeble heart, and accelerating a languid capillary circulation, though, for these objects to be fulfilled satisfactorily, there is necessity for great moderation and caution".

Excessive and Depraved Appetite

PERHAPS the most extraordinary instance of excessive and depraved appetite on record is that of a French soldier, named Tarare, whose case is described in vol. XXI of the *Dictionaire des Science Medicales*. . . . At 17 years of age, when only weighing 100 lb., he could eat 24 lb. of beef in as many hours. From the day of his admission to the army, he was ordered quadruple rations, with pickings and waste meat, but often slipped into the dispensary to finish off a poultice or two. One day he was observed to seize a large cat; and, after sucking its blood, left, in a very short time, only cleanly picked bones, the hair being rejected in the course of about half an hour. He was fond of serpents and eels, swallowing them whole. On another occasion he consumed in a few minutes a repast, spread out for fifteen German workpeople, of milk, etc., after which he was blown out like a balloon. . . . He fell under suspicion of having eaten a child fourteen months old.

Whence come Meteorites?

PROF. N. S. MASKELYNE, F.R.S., has an article under this title in which he discusses views put forward by M. Stanislas Meunier, of the Jardin des Plantes, Paris. "Whether M. Meunier's theoretical conclusions are to be looked on with the same favour that we heartily accord to his practical work is what we are about to discuss".

M. Meunier supposes meteorites to be the shattered morsels of a satellite smaller than and perhaps subordinated to the moon, which has run its course and been broken up by internal throes of volcano and earthquake. The fragments are thought to be "careering in every direction, retrograde as well as direct, around our world" and falling to the earth's surface in the order of their densities. Thus iron masses have already descended, stony fragments are now arriving, and the character even of these will change as time goes on.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, June 3

EUGENICS SOCIETY (at the Linnean Society), at 4.30 p.m.—Sir Bruce Bruce-Porter: "The Importance of the Child".

Tuesday, June 4

ROYAL INSTITUTION, at 5.15 p.m.—Dr. J. C. Spence: "The Feeding of Children".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN GENERAL ELECTRICAL ENGINEERING SUBJECTS—The Registrar, Municipal College, Portsmouth (June 8).

ASSISTANT SECRETARY OF EDUCATION—The Secretary for Education, Education Office, Barking Road, East Ham, E.6 (June 8).

LECTURER (WOMAN) IN GEOGRAPHY at the Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks (June 10).

PROFESSOR OF METALLURGY—The Registrar, University College, Singleton Park, Swansea (June 11).

LECTURER IN EDUCATION—The Registrar, The University, Manchester (June 15).

LECTURER IN BIOCHEMISTRY—The Secretary, The University, Aberdeen (June 15).

PROFESSOR OF PHILOSOPHY in the University of Durham—The Registrar, 46 North Bailey, Durham (June 15).

STUDENT-DEMONSTRATOR IN BOTANY—The Principal, Royal Holloway College (University of London), Englefield Green, Surrey (June 29).

LECTURER IN BOTANY at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 29).

SENIOR DEMONSTRATOR IN THE DEPARTMENT OF ANATOMY AND EMBRYOLOGY—The Secretary, University College, Gower Street, W.C.1.

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Library Catalogue of Printed Books and Pamphlets on Agriculture published between 1471 and 1840. Second edition. Pp. 294. (Harpenden: Rothamsted Experimental Station.) 12*s*. [85

Family Allowances. Pp. 32. (Aylesbury: The *Lancet*.) 3*d*. [95

School Canteen Handbook. Prepared by the National Union of Teachers and the Gloucestershire Training College of Domestic Science in collaboration. Pp. 48. (Cheltenham: National Union of Teachers.) 6*d*. [95

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 5: The Geology of Ardgour, Argyllshire. By Dr. H. I. Drever. Pp. 141–170+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4*s*. [95

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 17: Three Anomalous Dolphins from Blacksod Bay, Ireland. By Dr. F. C. Fraser. Pp. 413–455+plates 32–38. 4*s*. Vol. 46, Section B, No. 1: The Succession of Rocks in the Dingle Peninsula, Co. Kerry. By Dr. Robert M. Shackleton. Pp. 12+3 plates. 1*s*. 6*d*. Vol. 46, Section B, No. 2: Studies in Irish Quaternary Deposits—Some Lacustrine Deposits near Dunshaughlin, Co. Meath. By G. F. Mitchell. Pp. 13–38+plate 4. 2*s*. Vol. 46, Section B, No. 3: The Morphology of the Human Sperm and Egg. By J. Brontë Gatenby and Olive Aykroyd. Pp. 39–51+plate 5. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [105

Report of the Marlborough College Natural History Society for the Year 1939. (No. 88.) Pp. 60. (Marlborough: Marlborough College.) 3*s*.; to non-Members, 5*s*. [145

Strangeways Research Laboratory. Report for 1939. Pp. 24. (Cambridge: Strangeways Research Laboratory.) [165

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 24: New Observations on the Life-History of *Callitris*. By W. J. Looby and J. Doyle. Pp. 241–256. 1*s*. 6*d*. Vol. 22 (N.S.), No. 25: Atmospheric Pollution in Dublin during the Year 1939. By A. G. G. Leonard, Bridget P. McVerry and D. Crowley. Pp. 257–266. 1*s*. Vol. 22 (N.S.), No. 26: Studies in Peat, Part 8: Preliminary Note on Irish Peat Wax (Mona Wax). By J. Reilly and J. A. Emlyn. Pp. 267–272. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [205

Journal of the Society for the Bibliography of Natural History. Vol. 1, Part 10: A Facsimile of R. H. Beddome's articles on Indian Reptiles, 1862–1870. By Malcolm Smith. Pp. 273–334. (London: Society for the Bibliography of Natural History.) 15*s*. [205

Report for 1939 (No. 52) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Prof. J. H. Orton. Pp. 32. (Liverpool: University Press of Liverpool.) 1*s*. 6*d*. net. [215

The Fitzwilliam Museum, Cambridge. Annual Report for the year ending 31 December 1939. Pp. 10. (Cambridge: Fitzwilliam Museum.) [225

London Shellac Research Bureau. Supplement to Bulletin No. 5: The Hot Spraying of Shellac; a New Method of Coating Surfaces. Pp. 4. (London: London Shellac Research Bureau.) [225

Fourth Report from the Select Committee on National Expenditure. Pp. 60. (London: H.M. Stationery Office.) 1*s*. net. [235

Other Countries

International Institute of Agriculture. Studies of the Principal Agricultural Products on the World Market, No. 6: Olive and Olive Products, Production and Trade. Pp. v+224+19 maps. (Rome: International Institute of Agriculture.) 25 lire; 1.30 dollars. [95

The Archaeological Survey of the High Western Plains. Twelfth Report: Further Research Work in the Black's Fork Basin, Southwest Wyoming, 1938–1939. By E. B. Renaud. Pp. 93+3 plates. (Denver, Colo.: University of Denver.) [145

Proceedings of the United States National Museum. Vol. 88, No. 3080: *Cestocrinus*, a New Fossil Inadunate Crinoid Genus. By Edwin Kirk. Pp. 221–224. (Washington, D.C.: Government Printing Office.) [145

Brooklyn Botanic Garden Record. Vol. 29, No. 2: Twenty-ninth Annual Report of the Brooklyn Botanic Garden, 1939. Pp. 15–156. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [145

Lucknow University Studies. No. 13: Two Dimensional Potential Problems connected with Rectilinear Boundaries. By Prof. B. R. Seth. Pp. iv+124. (Lucknow: Lucknow University.) 2.12 rupees. [145

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 32: Studies in the Preservation of Fruit Juices. 1: Some Observations on the Preparation and Preservation of Citrus Fruit Squashes. By Lal Singh and Dr. Girdhari Lal. Pp. 25+1 plate. (Delhi: Manager of Publications.) 1 rupee; 1*s*. 6*d*. [145

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 186: A Singular Transformation in the Surface Layer of the Fe-Ni-Al System. By Syûiti Kiuti. Pp. 559–580. 55 sen. No. 187: Intense Combination-Tones produced by the Flutter of an Airscrew. By Jûichi Obata, Major Yûzô Matumura, Ryô Kanayama and Yahei Yosida. Pp. 26. 45 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [145

The Rockefeller Foundation. A Review for 1939. By Raymond B. Fosdick. Pp. 72. (New York: The Rockefeller Foundation.) [145

U.S. Department of Agriculture. Circular No. 555: Fumigation of Vetch Seed for the Vetch Bruchid. By A. C. Johnson, J. S. Pinckney, J. W. Bulger and A. M. Phillips. Pp. 11. 5 cents. Leaflet No. 195: Mealworms. By R. T. Cotton. Pp. 5. 5 cents. Miscellaneous Publication No. 371: A Revision of the North American Aphids of the Genus *Myzus*. By Preston W. Mason. Pp. 31. 5 cents. (Washington, D.C.: Government Printing Office.) [145

Bureau of Education, India. Progress of Education in India, 1932–1937. Eleventh Quinquennial Review. Vol. 1. Pp. x+286. 3.2 rupees; 5*s*. Vol. 2: Statistical Tables and Appendices. Pp. vii+270. 4.4 rupees; 6*s*. 9*d*. (Delhi: Manager of Publications.) [165

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Tests on the Liquefaction of Canadian Coals by Hydrogenation. By T. E. Warren and K. W. Bowles. (No. 798.) Pp. viii+106+2 plates. (Ottawa: King's Printer.) 25 cents. [205

Fouad I University: Faculty of Science. Annual Report, 1938–1939. Pp. iv+56. (Cairo: Fouad I University.) [205

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1939. Pp. 20+2 plates. (Pretoria: Government Printing Office.) [205

Comité National français et Comité National marocain de Géodésie et Géophysique. Année 1938. Compte rendu publié par le Secrétaire général du Comité français, G. Perrier. Pp. 148. (Paris: Comité National français de Géodésie et Géophysique.) [215

Annales de l'Institut de physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurier. Tome 17. Pp. iv+124. (Paris: Les Presses universitaires de France.) [215

Dominion of Canada. Report of the Department of Mines and Resources, including Report of Soldier Settlement of Canada for the Fiscal Year ended March 31, 1939. Pp. 351. (Ottawa: King's Printer.) 50 cents. [215

Geological Survey of British Guiana. Bulletin No. 14: Report on Gold and Manganese Deposits of the Lower Barama River, Northwest District. By Dr. D. A. Bryn Davies. Pp. iv+32+6 plates. (Georgetown: Geological Survey of British Guiana.) 24 cents. [235

Catalogues

'Viterals', Vitamins and Minerals: Correctly balanced Proportions of Life's Necessities. Pp. 4. (London: Viterals, Ltd.)

Old Science and Medicine. (Catalogue 56.) Pp. 48. (London: E. P. Goldschmidt and Co., Ltd.)

British Made Gauge Movements for Vacuum, Pressure, Oil, Steam. Pp. 4. (Coventry: Rotherham and Sons, Ltd.)

Rotary Pumps for the Production of High Vacua. (Rot. 4) Pp. 12. (London: W. Edwards and Co. (London), Ltd.)

Fersolate Tablets. Pp. 12. (Greenford: Glaxo Laboratories, Ltd.)

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Vol. 145 SATURDAY, JUNE 8, 1940 No. 3684

THE REPUDIATION OF TRUTH

LEADERS of the various faiths delivered no uncertain message on May 26, the Day of National Prayer. With one voice they proclaimed the Allied cause to be the cause of freedom, truth, decency, and civilization.

"We are called," declared the Archbishop of Canterbury, "to defend our land and all that we hold dear within it, the wider Commonwealth that has so wondrously grown up around it, and our common heritage of freedom. Please God, this we shall do with all our might. But more than this —we are called to take our place in a mighty conflict of Right against Wrong. The ruthless invasions of peace-loving countries . . . have shocked the moral conscience of the world, at least where that conscience is free to act and speak. They lay bare a mere unbridled lust of power, under whose pressure all the old sanctities of truth, justice, mercy, and freedom are trampled under foot. To hesitate to brand this force which has been let loose upon the world as essentially evil would be to scorn all those moral standards which have been slowly and painfully established by mankind to give security and honour to the common life."

The Archbishop of York spoke to similar effect:

"The whole future history of Europe is at stake. Upon the issue of the conflict now joined the quality of civilization in the coming period depends. Our cause is the cause of freedom and mutual trust. With the German method of the broken promise goes contempt for the rights of the weak and the small. In such a world there can be no justice and no freedom."

Cardinal Hinsley, Archbishop of Westminster, uttered a vigorous denunciation of the Nazi regime:

"Peace has been murdered between nations because the party in power in Germany has avowedly cancelled truth from its programme, and has declared that our traditional Christian civilization is to be shattered by the might of the 'immortal Nordic race'. This new racial idolatry justifies to its votaries everything that the party wills for its own interests.

"For years past the youth of the German nation have been trained to use the discoveries and inventions of science, the fruits of industry, all their energies and talents, for the glory of total warfare. The gospel of pride and hate has been loudly preached to a large, receptive audience, unhappily comprising the mass of the German nation.

"Now at length Christians understand. No liberty is possible, no decency in human life, if a pagan people may subdue by its fury, and scourge with scorpions, the rest of mankind."

The Rev. Leslie Weatherhead, speaking in the City Temple, said:

". . . we are placed in the dreadful dilemma of either using the awful and ghastly weapon of war —a weapon chosen by our enemies after every other means of settling differences had been tried by us; or else enlarging—perhaps through the world—an area in which the Nazi evil is rampant; an evil in terms of broken promises, persecution of Christian and innocent people, the torturing of Jews, the denial of freedom, the suppression of truth, the imprisonment of pastors, the idolatry and supremacy of the State over all the rights of the individual, and perhaps worst of all, the training of little children, for generations ahead, to worship the idols of war, tyranny and oppression. Whatever we may feel about our own individual attitude to war, surely we are trustees for the generations to come, and must do our utmost not to let go the liberty which is *their* birthright."

The General Assembly of the Church of Scotland on May 25 affirmed that

"the present war is not merely a clash of nations, or merely a war of defence of national boundaries and Empire interests, but a mortal combat, the outcome of which will determine for many generations whether a large part of the world is to live under conditions of increasing freedom and honesty and truth and light. . . ."

The Chief Rabbi, Dr. Hertz, added his testimony:

"Nazism is the enemy of man, and our whole spiritual heritage—human brotherhood, human freedom, human decency—is being jettisoned by the pirate captains of the Nazi ship of State."

The World Congress of Faiths invited Hindu, Moslem and Buddhist leaders in India and Burma to join in the observance of the National Day of Prayer. Christians, Jews, Mohammedans and Hindus attended churches, synagogues, mosques and temples throughout Malaya on the same day.

Such unanimity is good evidence of the feeling of moral revulsion aroused among religious leaders of all faiths by the Nazi regime. It is clear that to them the present conflict is a struggle between civilization and barbarism. The reasons for viewing it in this light are evident. In what does civilization consist? Not in material wealth or productive power, not in the amenities and comforts of life, not in an advanced scientific technique, not in organization and machinery, not even in literacy and education. It is possible to enjoy all these benefits and be civilized, but it is no less possible to enjoy them and be barbarous. All these are external matters and do not touch the spirit of a community, and it is the spirit that is civilized or barbarous; other things are external trappings only, which may be impressive or comparatively poor; they scarcely matter. The civilized tradition seems to be characterized by, and based upon, a twofold reverence, that is, reverence for the human being as such, and for truth as a supreme value.

Where these two are respected, there civilization can be said to exist, even if there be only a modest material equipment. Neither laboratories nor factories, nor of necessity educational establishments, of themselves make a State civilized. It may be said that there have existed civilizations in which respect for the individual as such, and for truth, has been absent or in abeyance; but such cultures, if they have existed, have been alien to the tradition to which European civilization belongs, which is a tradition of tolerance and respect for truth and personality. These principles may often have guided actual practice very imperfectly; but however far the majority of people have fallen short, they have not actually turned their backs upon them. For that we have had to wait until the present generation, and now over a considerable area of Europe, traditional ideals are denied and scorned. The unique individual has now become a unit indistinguishable from other units, a cog in the military, industrial, or political machine. As a human being he has no rights as against the divine State, for the sake of which he exists, and from which he derives any trivial value that may inhere in him.

As for truth, both in the sphere of scientific theory, and in that of public and private behaviour, it has been cynically repudiated. Science, whether in biology, anthropology, psychology, or history has been subordinated to the needs of propaganda and imposed dogma. It is inspired no longer by the love of truth but by the interests and policy of a party. As for truth in action and behaviour, it has been displaced by the most cynical lying and treachery.

The present conflict, then, is one of civilization against its negation, and is a struggle for the preservation of individual freedom of speech and thought, as well as for the preservation of the sanctity of international and other agreements. There have been many suggestions that this is a war of Christianity against Paganism, but the fact would seem to be that the principles above described as being integral to civilization, namely, respect for the individual human being and for truth, are fundamental to all spiritual and moral religions—Christian and otherwise. Spiritual religion as an activity, not only of the group but also of the individual moral personality, involves the belief in freedom, and through its claim to establish contact between the devotee and the highest reality, involves the belief in the supreme value of truth. History shows how closely ideals of freedom and truth are bound up with spiritual and moral religion, and how prominent has been the part played by religion in the development of the civilized tradition—the tradition which is now under threat of demolition.

"The essence of all great religious systems," writes Sir Richard Gregory in his recently published "Religion in Science and Civilization"*, "is belief in the attainment of high ideals by devotion of service to them. Different individuals and communities require different doctrines and rituals to bind them together in worship of any kind, but all such formularies are only ancillary aids to a universal faith in the possibility of ascending towards the highest good by human endeavour."

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* Religion in Science and Civilization. By Sir Richard Gregory. Pp. xiii+366+16 plates. (London: Macmillan and Co., Ltd., 1940.) 12*s*. 6*d*. net.

But not only is the present a struggle of true religion against idolatry (idolatry being the worship of the creature, for example, the State, and not of the Creator), but also it is a struggle of science against superstition. Not only is the Nazi doctrine of racialism, the *völkisch* philosophy of life, a pseudo-scientific dogma, but also the interpretation of evolutionary theory which the Nazis borrowed from Nietzsche, is crude and barbarous in the extreme, being what T. H. Huxley characterized and repudiated as "the gladiatorial theory of existence". Sir Richard Gregory, in the work above mentioned, quotes the noble and well-known passage from the Romanes Lecture in which those words occur, and adds, "This is the religious message of science; and all the evils of civilized life arise from the neglect of it by individuals and communities". Huxley's words have a singular relevance to-day:

> "The practice of that which is ethically best involves a course of conduct which, in all respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competition, it requires that the individual shall not merely respect but shall help his fellows."

On the human level, the further advance of the creative process demands co-operation rather than strife; thus the Nazi doctrine is reactionary as well as puerile. As for the glorification of war, popular in Nazi and some other circles, history and anthropology give little justification for it.

> "War represents only one phase in the development of civilization," writes Sir Richard Gregory, in a fine chapter on "The Cultural Aspects of War". "The contribution to advancement by peoples has not been through their warlike qualities, but by other thoughts and actions. The spiritual evolution of man, as represented by all that is best in civilization throughout the ages, and as inspired by the most exalted and ethical teachers, has not proceeded in its upward course through war but in spite of it."

But it is indeed in no spirit of glorification of war or race that the present struggle against the enemies of the European cultural tradition is being waged. The same writer makes this clear:

> "When the deliberate policy of a State is to impose its system by force upon people who wish to be free and have entirely different ideals, all believers in liberty of conscience and in the principles of natural cultural development should range themselves against such aggression."

It is a bitter tragedy; but yet more calamitous would be the tragedy if the cause of civilization were allowed to go by default.

PROGRESS OF THE ROYAL SOCIETY

The Record of the Royal Society of London for the Promotion of Natural Knowledge

Fourth edition. Pp. viii + 578 + 19 plates. (London: Royal Society, 1940.) 21*s*. net.

IT is twenty-eight years since, at the 250th anniversary of its incorporation, the Royal Society last issued an edition of its "Record". A possessor of the volume of 1912 will find, on studying that of 1940, that, although the two are almost uniform in outward and inward physique and necessarily have various parts of the text in common, there is so much that is new and valuable in the present edition that ownership of the earlier volume does not exempt him from having this also. Nor should its use be limited to scientific persons: any student of the general history of our time who ignores it, or treats cursorily what it can show him, would miss something that is vital to his theme.

Those topics which are common to both editions have evidently been examined *de novo*; and no sentence, passage, or section has been reprinted unless its facts, its phrasing, and its place in the newly told story have stood against the keen scrutiny which time and the recorder have exercised. The account of the foundation and early history, which occupied 47 pages in 1912, is matched now by 85 pages—Chapter i—on the rise and growth of the Society, in which new matter of the seventeenth century is introduced in a rearranged story, and wholly new sections describe the Society in the eighteenth century (10 pp.), the nineteenth (21 pp.), and the twentieth up to the recent breakdown of that remarkable period (12 pp.). The texts and translations of charters, and the statutes, formerly in the main text, are now transferred to appendixes, as are the lists of patrons, officers, medallists and lecturers, with the complete chronological and alphabetical lists of the fellows from 1663 until 1939 (some 6,000 in all), and an interesting table and graph of the numerical progress of the fellowship. These appendixes fill about 350 pages. The index of 9 pages is twice as long as that of 1912, and much more than twice as useful. Chapters ii–ix of the main text, covering about 130 pages, give notes on the charters and on the statutes, and describe lucidly the various funds and benefactions, the library and collections, the committees, and the publications: in all which accounts, there is maintained the nicest balance between fact and commentary, with just enough of the latter to cause the whole to cohere, and to enable the reader to see perspectives as they should be seen.

In other domains of human enterprise, it may often be noticed that a growing interest in the past marks a decline of real vigour in the present. That growth is manifest here; but emphatically not the decline. Indeed, even though the "Record" scarcely touches (except in the lists of the subjects of special lectures) upon the specific advances in science for which the Society has stood sponsor, the reader who notes those corporate activities which belong to the last twenty-eight years can scarcely fail to judge this period as being, in many ways, the most vigorous and fruitful in any of the four centuries which the Royal Society has helped to shape.

The last phrase is no hyperbole. But it is inevitable that scientific ideas and knowledge should always be anachronisms of anticipation, ahead of their historical date as this is measured by the calendar and assessed by the conventional historian; and therefore a far-sighted generation, that would cater for its own posterity's needs, does well if it encourages its scientific men. That our generation from 1912 until 1939 has not lacked persons of such foresight, as well as the means to exercise it, can be learnt from Chapter iv, and is seen at a glance in a very concrete way from the table on p. 78 in Chapter i: the Society's funds, which in 1900 were put at £169,445 and in 1913 at £179,735, in 1937 were put at £893,134. More than three-quarters of this capital is held for the direct aid of research, producing to this end an income exceeding £30,000 yearly—some thirteen times as much as was available in 1912—with which have lately been endowed the distinguished and productive professorships and studentships, of which the purposes and the holders' names are recorded in Chapter iv. Not only have the Society's own funds thus grown (though there is still much need for additions free from restrictions other than at the Council's discretion), but also the Parliamentary grants-in-aid which the President and Council administer are much greater than formerly: for example, that for scientific investigations is now £7,000 annually, that for scientific publications £2,500; and other responsibilities have also been accepted.

The nineteen illustrations in the volume have been thoughtfully chosen; and the reproduction of portrait-subjects at full length is an artistic improvement upon the practice of 1912. A reviewer may be suspect if he have *no* cavil: all I can do to meet this is to note that an interesting part of John Wallis's letter of 1696–97 has been omitted; and, concerning Plate 11, to question whether the design of John Tate's watermark (not "wire-mark", by the way, which is a different thing) is properly described. But these things matter nothing: the review should end as it began, adding only the fact, modestly mentioned in the President's preface, that the preparation of this "Record" was mainly in the hands of Sir Henry Lyons, lately treasurer of the Society.

J. I. O. MASSON.

BIRD PORTRAITS

Intimate Sketches from Bird Life

Written and Illustrated by Eric J. Hosking and Cyril W. Newberry. Pp. xx+104+53 plates. (London: *Country Life*, Ltd., 1940.) 5*s*. net.

THE study of birds has long absorbed the mind of man. Since the days of Willoughby, through the centuries to Bewick and St. John, and down to our own time, ardent naturalists have not been wanting to chronicle the habits of birds. The camera has brought an added, though harmless, weapon into the armoury of these naturalists. Had the camera been invented in St. John's day he might perhaps have laid aside his gun, and photographed, rather than shot, the ospreys and other rare Highland birds which he, keen naturalist though he was, did not hesitate to slay.

It is good to think that we now protect and study our remaining birds; by means of photographs their shy lives are brought vividly and faithfully before a large public prevented from seeing these birds (or at all events the rarer ones) themselves.

One of the early pioneers in bird photography, and undoubtedly the best known, was Richard Kearton, whose enthusiasm was tremendous. He photographed birds from a stuffed ox, sometimes from a stuffed sheep. Cameras, and photographic plates and films, had not reached their present-day perfection, yet if Kearton's photographs be examined, some of them, even by present-day standards, are still well-nigh perfect, although almost half a century has passed since Kearton began his work.

Many persons, their enthusiasm fired by the early workers, have followed their example and have published their photographs in book form. The present book, by Eric J. Hosking and C. W. Newberry, is a comparatively small and unpretentious work, yet the photographs which illustrate it are in the very first class—I doubt whether anything better of their kind has been published. It is, perhaps, a pity that the identity of the photographers is not revealed beneath each picture. For example, one is left in the dark as to whether it was Mr. Hosking or Mr. Newberry who took those really beautiful photographs of the stone curlew at home, but it is perhaps to be inferred that the joint authors of the book worked together.

The letterpress of the book is inferior to the photographs, but there are recorded interesting first-hand observations—for example, the pied flycatchers of a valley of Wales began to nest only a few hours after their arrival at their summer haunt, and "the modern flash bulb, which gives a short flash without noise or smoke, has no disturbing effect on many wild birds, which apparently regard it as a natural phenomenon, perhaps akin to lightning" (p. 49). The authors also describe the excitement of a cock partridge, on being called to the nest by the hen, to see the first-born chick. On p. 40 is found what may be a very modest statement, "Our work was interrupted by an accident while working on a tawny owl". Can this have been the ferocious tawny owl which attacked Mr. Hosking and caused the loss of one of his eyes? Yet even after that, Mr. Hosking, although he says nothing of it in this book, refused to admit defeat, or to harbour ill-will against the owl, but continued to photograph it after a few days' rest. The series of woodcock photographs are particularly fine, and there is an excellent buzzard series.

The authors do their best to prove that the little owl is not the villain it is generally supposed to be, but there would seem to be a good deal of contrary evidence—witness the great destruction worked by a pair of little owls among the storm petrels of Skokholm. SETON GORDON.

THE CELL THEORY

Hundert Jahre Zellforschung

Von L. Aschoff, E. Küster, W. J. Schmidt. (Protoplasma-Monographien, Band 17.) Pp. x + 285. (Berlin: Gebrüder Borntraeger, 1938.) 16 gold marks.

BEFORE he can come near to understanding the complicated structures and immense variety of form encountered in the living world, the natural scientist has to reduce them to their simple ultimate components. These elementary units should be able to live by themselves, and also to combine with each other to produce more and more complex systems. The search for the fundamental unit of living matter was greatly influenced by the thought of Leibniz, while Brown, Bichat and Purkinje among others looked for such components. It was not, however, until Schleiden put forward his cell theory in 1839 that general agreement as to the nature of the elementary unit was reached. Schleiden's theory provided both a sound basis and a guiding principle for the study of the microscopic structure of plants, which were soon applied to normal animal tissue by Schwann, and to pathological material by Virchow. The cell theory thus gave a new and vigorous impetus to microscopic investigation, as well as leading to the development of specialized techniques.

Küster, Schmidt and Aschoff have taken the opportunity afforded by the centenary of the first enunciation of the cell theory to publish a little book in which they not only trace the broad outlines of the course and general results of cell research during the last hundred years, but also examine the validity of the cell theory in the light of our knowledge to-day. On reading this book one is not only impressed by the progress made in this field since 1839, but also by the amount which was known of the structure and function of cells before ever the cell theory was formulated.

As commonly understood, the cell theory contains two main statements: (1) that the cell is *the* elementary form of life, and (2) that every organism is composed of cells and cell derivatives. While the book under review contains an adequate summary of research done during the last hundred years, that part of the book concerned with the examination of the validity of the cell theory is rather disappointing, because of the authors' rather uncritical tendency to accept the traditional outlook. They agree that the first statement of the cell theory needs modification, since viruses cannot be regarded as cells, and that there must, therefore, be more elementary forms of life than the cell. Schmidt believes in various degrees of life and in the transition of the non-living into the living organization. Aschoff favours this conception, but does not reveal how he reconciles it with his acceptance of Virchow's law, *omnis cellula e cellula eiusdem generis*. All three authors accept the second contention of the theory, and believe that research during the last hundred years has not produced any results incompatible with it.

In considering the validity of the cell theory, one may perhaps ask whether the term 'cell' is sufficiently well defined. Most botanists, speaking of the cell, think mainly of the cellulose wall and its lignified derivatives, while the geneticist is concerned for the most part with the chromosomal structure, and the biochemist has in mind an aggregate of enzymes enclosed within a semi-permeable membrane. Thus the very meaning of the word 'cell' tends to vary with its context. Further, the character of every actually existing cell depends on the tissue and species of organism from which it is derived, and even in tissue culture cells retain these characteristics and do not become simple living elements. Thus it is impossible to conceive of the cell as a sort of chemical atom, an elementary unit of interchangeable qualities.

It is true that no understanding of structure and form in the living world is possible unless cellular organization is taken into account, but at the same time the reduction of an organism to a combination of similar elementary units is not sufficient to explain the differentiation and functional structure of the different organs and tissues involved. Consequently a number of new conceptions, such as the field theory put forward by Child, Heidenhain's *Teilkörper* theory and the theory of functional systems, are being tried to supplement the cell theory. Unfortunately, Aschoff dismisses all these attempts as being of no importance since they can be worked into the cell theory.

A. GLÜCKSMANN.

RELATIONSHIP OF CRIME AND INTELLIGENCE

Intelligence and Crime

A Study of Penitentiary and Reformatory Offenders. By Simon H. Tulchin. Pp. xiii+166. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 12*s*. net.

THIS investigation is primarily an inquiry into the relation between crime and intelligence. But the bearing upon crime of other variables such as age, height, weight, nativity, educational record and employment is also taken into account. The subjects are 4,748 males at the Illinois State Reformatory, 5,512 males at the Illinois State Penitentiary and 153 penitentiary females. The research was carried out over a period of seven years.

No doubt this is a very painstaking piece of work, but the results are presented more as raw material for further study than as data thoroughly analysed. Three criticisms, in particular, suggest themselves. First, the control groups are inadequate. Secondly, no tests of significance are applied to the large number of differences between means; nor is any analysis of variance attempted. The reader is thus left guessing how many of the observed discrepancies are attributable to chance. Thirdly, the grouping of the criminals into only seven types of crime is much too crude a classification for a thoroughgoing analysis. The seven types of crime are fraud, robbery, larceny, burglary, murder, sex, and a group described as miscellaneous.

In spite of these defects, the reader feels that certain important conclusions can be accepted. Serious doubt is thrown upon the traditional view of Goddard, Healy and others that there is an abnormally high percentage of feeble-minded among the criminal population. Tilchin shows, on the other hand, that the distribution of ability in his criminal subjects scarcely differs from the distribution in adequate samples from the general community in the United States as, for example, in the American Army samples. Moreover, as Murchison had found earlier, the ability of the offender is definitely related to the type of crime he will commit. The fraudulent are generally the most able. Age and height are also relevant factors in determining types of crime. Finally, scores on the tests used, far from measuring 'innate' ability, correlate significantly with environmental factors such as place of birth, length of residence in a particular region, and educational level.

J. I. COHEN.

AN EAST AFRICAN PEOPLE

The Social Institutions of the Kipsigis
By Dr. J. G. Peristiany. Pp. xxxiv+288+24 plates. (London: George Routledge and Sons, Ltd., 1939.) 18*s*. net.

THE Kipsigis, better known among Europeans and to an earlier generation of anthropologists as the Lumbwa, are numerically the most considerable group of Nilotic Hamites in Kenya, their nearest affinities being the Nandi, Suk, Kamasia and Turkana. With the Masai they have a traditional enmity, which they trace back to the time of their first entry into the country they now occupy. This migration, it is to be presumed, was from the north.

The literature relating to the Kipsigis, though not entirely lacking, is scanty, and from the point of view of modern anthropological method, partial and inadequate. This is the further to be regretted, since the recorded observations of the related peoples, Nandi and Suk, dating for the most part from the first decade of the present century, are both scrappy and self-contradictory. It is pointed out by Dr. E. E. Evans-Pritchard in his interesting introductory analysis of Dr. Peristiany's material to what an extent these present observations among a closely related people serve to throw light on previous obscurities in these early records. In this connexion it may be mentioned as significant of the degree of inter-tribal relation that a Kipsigis crossing into Nandiland fits into the age-set corresponding with his own, and is at once accepted as a member of it.

The social organization of the Kipsigis is of a highly complex character. The fundamental system is local. The basic unit is the village, built up from family holding and hamlet. The villages in their turn combine to form the shire, and the shires the higher unit of the province, four of which constitute the Kipsigis tribe or nation. There are no chiefs, but in each grouping, political and juridical, military and ritualistic leaders regulate the departmental affairs of the group, with the assistance of the elders, who virtually control the action of the leaders and give effect to the democratic character of Kipsigis institutions. Economic affairs stand outside this hierarchy of leadership. Here the village organization with its economic leader is the effective unit standing alone, its special function being that of facilitating and ensuring co-operation between its members. So deeply engrained is this principle of co-operation on a local basis, that assistance will be tendered to a neighbour in preference to a distant kinsman.

The complexity in a social system thus built up upon a gradation of locally organized units is intensified by other methods and systems of classification of overriding significance, which cut across local organization. Among these may be mentioned the regimental system for raiding purposes, under which each individual is born into a regiment, although it is possible to be designated to an alternative—but in either event the regimental affiliation is independent of territorial claims; the age-set, by which the whole community, including in so far as applicable the women, is divided up into three age groups of the young or uninitiated, the warriors, and the elders; and the clan system, based upon totemic non-exogamous groups, subdivided into exogamous branches, each with its distinctive totem, from which the members take their name, these sometimes being still further subdivided, the exogamous unit then becoming the lower division.

The various affiliations of which the individual is the centre or focus tend to eliminate the parochialism which might, or indeed would inevitably, result from a purely local system, and bind the Kipsigis into one people. This effect is enhanced by other institutions, such as for example the practice followed by wealthier individuals of planting out the homesteads of their various wives in different parts of the country, or depositing a number of their cattle in the keeping of friends and connexions. As to how far it would be safe to attribute outstanding importance to any one influence on the life of the individual it is difficult to say; but just as initiation, which admits to the warrior age-set, is the outstanding event of a lifetime, so the age-set, which determines the character of the social activities of every member of the community, would seem to overshadow all other affiliations. Dr. Peristiany not only gives a detailed account of the elaborate initiation ceremonies, but also discusses their place in the regulation of tribal life and conduct, while touching upon the effect of certain changes which have taken place in them in recent years.

Following on his account of this complex social organization, Dr. Peristiany has described with a wealth of detail its various ramifications and its effect on the family—marriage, economic life, inheritance and property, war, hunting, religion and other departmental institutions in the community. His scholarly study is a valuable addition to the literature relating to the less familiar peoples of East Africa.

PREVENTION OF MALARIA IN INDIA

RECENT ADVANCES

By Sir Malcolm Watson,

Director, Ross Institute of Tropical Hygiene

ALTHOUGH the primary object of my recent visit to India was to see what progress had been made in preventing malaria on estates advised by the India Branch of the Ross Institute, I took the opportunity of visiting Delhi and Hyderabad, Deccan. In all these areas astonishing progress has been made since my visit in 1928–1929.

For more than a thousand years there has been a succession of cities on the western bank of the River Jumna within six miles of new Imperial Delhi. Some of the cities were far enough from the river to escape the malarial mosquitoes which breed in pools in its bed. But three hundred years ago Shah Jehan made the mistake of building his city right on the river bank; the Western Jumna Canal irrigated its northern area; the Darhalia Nala flowed through the western suburb. In all three, *Anopheles culicifacies* bred in profusion; and at times Shahjehanabad was the most malarial military station in India. In 1903 the General Officer commanding the Division commented on "the havoc caused in the Delhi Fort garrison". Of the relieved force, 315 per 1,000 were unable to march back to Meerut, and of the remainder quite one fourth were scarcely fit to carry arms. A few years later the cantonment of Daryaganj in the south-east corner of the Fort and immediately on the Jumna was abandoned on account of malaria. New Delhi, built not quite so near to the river as its immediate predecessor, provided accommodation for myriads of *A. culicifacies* in the four hundred miles of margins of concrete tanks which adorn the new capital. Further accommodation for the anopheles was provided in pits in two hundred acres of brickfields and in innumerable artificial obstructions to natural drainage channels.

To-day a five years programme for the control of malaria is well advanced. It covers the eight miles of river bank and the various streams and canals falling into the river, the irrigated area, the brickfields and much besides: good sound work that is producing the required result. Indeed, Daryaganj, the abandoned, is now being developed as a residential area.

Not less interesting, and of great importance to India, is the control of malaria in sixty-six villages within three miles of the city, and in sixty villages farther afield. The work is being done after careful study of the habits of the dangerous anopheles, *A. culicifacies*. Depressions have been filled, and the land sloped to run all surface water to one or more of the village tanks, where any mosquitoes that breed can easily be destroyed. While concentrating on the prevention of malaria, water supplies have been improved, and the general cleanliness of the villages has not been neglected. The co-operation of the villagers has been secured. The anti-malarial work at Delhi is under Lieut.-Colonel Covell, director of the Malaria Institute of India. It costs money—often much money—to repair mistakes that could have been avoided in the original work without additional expense. Now co-operation between the various authorities prevents more man-made malaria, and I was impressed by the economy and efficiency of the work.

The prevention of malaria by the Government of India has not been confined to Delhi Province. The Government of H.E.H. the Nizam has reduced the percentage of children suffering from malaria in the old city of Hyderabad (one of the worst areas) from 55 to 0·5; a suburb of the city, falling into decay in 1929, is now thriving and land values have risen; a completely new suburb has been built on land previously regarded as uninhabitable. Twenty years ago there were 16,000 deaths a year from plague, now there are 100 or less. Slum clearance proceeds rapidly, and there are many attractive rehousing schemes. Some of the small houses, the economic rent of which would be Rs. 3 a month, are let at Rs. 1 a month to those who abjure alcohol. These houses have pillars shaped like inverted tumblers —a reminder of the pledge. Improvements in many other ways have been made, and with its progressive Government Hyderabad is becoming a model Indian city; nor have the improvements been confined to the capital of the State.

For more than two months I toured estates in southern India; the Surma and Assam valleys; and the Dooars, an area under the shadow of the Himalayas. In many of these districts malaria had been intense and blackwater a too frequent visitant. Since I made much the same tour eleven years ago a great change has occurred. Almost everywhere on the estates the prevention of malaria is in active progress. Confidence has replaced pessimism; on many estates managers, assistants and medical officers are full of enthusiasm at the wonderful results achieved. Although I made constant inquiry I heard of no case of blackwater fever in a European in the last two years.

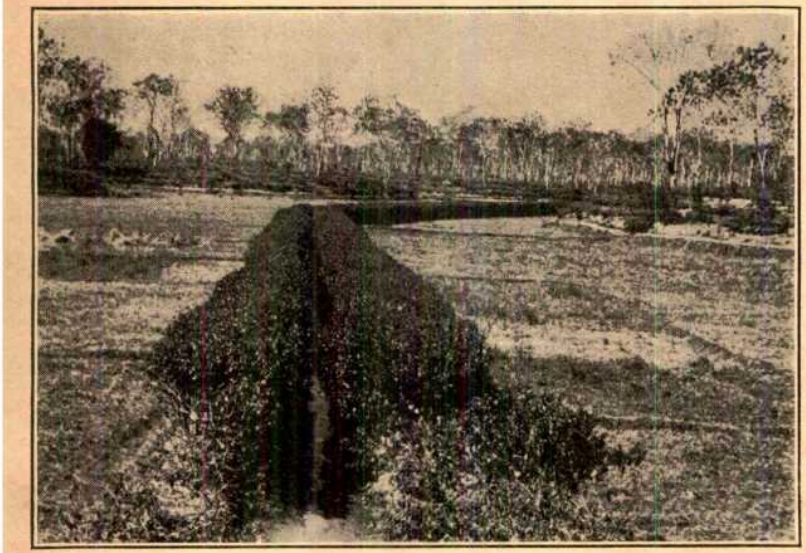
Sixteen years ago, when I spent three months in Assam on the invitation of the directors of the Doom Dooma and its associated companies, the control of malaria by controlling mosquitoes was regarded as impossible. The Assam Valley, or syncline between the Himalayas and the Burma Hills, three hundred miles long and fifty miles wide, is, I am told, filled with detritus from the hills to a depth of three miles. To the eye it appears a level plain, and it well might as it was formerly an arm of the sea; even now the Brahmaputra River is navigable almost the whole length of the valley throughout the year. In the spring the melting snows of the Himalayas and vast areas of Tibet make it one of the mighty rivers of the world, five to seven miles wide. Its waters flood back into the local rivers, mere tributaries of the Brahmaputra, but some wider than the Thames at Westminster. Then with scarcely an interval come the monsoon rains—80–120 inches in less than six months. Hundreds of square miles disappear under water; for wherever possible water is stored by the Assamese, whose staple food, rice, is grown in sheets of standing water. Can we wonder that more than twenty species of anopheles have found the valley a happy home, or that to the earlier investigators the malarial problem of controlling mosquitoes seemed insoluble?

My researches in Assam, and more than twenty years experience of Malaya, led me to take another view. Between 1900 and 1910 the combination of research and practical work in Malaya showed the openings in the mosquitoes' armour. The work had included, in addition to laboratory work, large-scale experiments in which miles and years took the place of millimetres and minutes; for the malaria problem could not, in the end, be brought within the four walls of any laboratory. We had learned that, although there were many species of anopheles all of which could be artificially infected in a laboratory, few became infected when wild, and happily few areas had more than one dangerous species; that to control malaria we had to control only the dangerous species; that the larvæ of the different species lived under different conditions of light and shade, of stagnation or movement of water; that changes in these conditions or in the chemical composition of the water would change the species present; and that a method of control 100 per cent successful against one species might be worse than a failure against another species. For example, *A. maculatus*, the larvæ of which live in hill streams, sparkling in the sunshine, required very different measures of control from *A. umbrosus*, an inhabitant of jungle-covered stagnant swamps. So came about what is known to-day as 'species sanitation'; and in 1910, at a public lecture, I stated that following the methods of limiting and changing species shown to us by Nature, "a great anti-malarial method will be evolved . . . we shall be able to play with species of anophelines, say to some 'go' and to others 'come', and abolish malaria with great ease, perhaps at hardly any expense. Drainage may become a method of the past. . . ." In addition to other methods of malaria control like site selection and oiling, Nature's methods are widely employed on estates in India to-day.

Dr. G. C. Ramsay followed up my researches in India. He proved *A. minimus* to be the only important carrier of malaria on the estates in his practice, and went on to control it. In 1930 he was appointed head of the India Branch of the Ross Institute. His scheme of training young Indians has been expanded by Dr. Manson, Dr. Fraser and other medical officers co-operating with the Ross Institute, and to-day more than five hundred trained Indians are employed on estates to identify the species of anopheles caught, to dissect them to see if they are infected with malaria, to collect anopheles larvæ and prepare maps showing the breeding places of the different species. Small field research stations have been temporarily opened in different parts of India from Cape Comorin to the Himalayas, from Sind to Assam. More than two hundred thousand anopheles have been dissected and several species have been convicted of carrying malaria. There are now one or two permanent training centres to meet the demand for trained malarial surveyors—a new and useful form of employment for the educated Indian fresh from school.

To control the different species of anopheles appropriate methods are employed. A description of some of them would be strange reading for those who were taught only of the danger of jungle, of stagnant water, and swamps, and have not been initiated into the secrets and mysteries of modern malaria control.

For example, on many estates in India, as in Delhi, much malaria has been 'man-made'. Over wide areas of both northern and southern India, the malaria is entirely due to man interfering with Nature by his clearing away jungle from streams and exposing them to the sunshine, and by his draining swamps. For by doing so he has driven out the jungle-loving or harmless species and permitted the breeding of dangerous species—*A. minimus* in the north, *A. fluviatilis* or *A. culcifacies* at different elevations in the south. Intermittent flushing will wreck the home of even the fastest stream-breeding malaria-carrier in the world; it is much used in India. Streams are flushed by hand-operated openings in simple earth dams; by automatic tippers, costing a shilling or less, of a design that would rejoice the heart of Mr. Heath Robinson; or by more elaborate things of concrete and iron. In other places, if man holds his hand, Nature will cover up her wounds with secondary jungle, but often she is too slow and we must replant appropriate shade. So we see the strange sight of hundreds of acres of little squares of almost stagnant water growing rice in the sunshine, and down the centre of the rice fields a stream densely shaded by a hedge; it may be of the lovely shoe flower (Hibiscus), the wild rhododendron (Melastoma), the notorious Lantana or other plants. The centre stream alone was the danger. The hedge has made it harmless, and an intense source of malaria has been eliminated. The accompanying photograph shows a rice field in the dry weather with the hedge pruned to make the shade denser in the rainy malarial season. There are 2,000 miles of these dense hedges now, and 4,000 miles will be effective by the end of the year.



ANTI-MALARIAL HEDGE IN A RICE FIELD (PRUNED IN NON-MALARIAL SEASON).

Progress has not been confined to the prevention of malaria. I was astonished to see the general improvement in the water supplies, in latrine accommodation, in refuse collection and disposal, in housing of the labourers, in the hospital buildings and the high standard of medical work in so many of them, the care of the sick and the ante-natal work.

From a commercial point of view, a remark made by the head of one of the largest tea-producing concerns in India represents the general opinion: "We have gone carefully into the figures and are convinced of the value of malaria control"; and he added, "in fact we have some of the finest examples of the control of malaria both in north and south India", for the truth of which remark I can vouch. The following are figures from one group of estates, representative of many:

	1927 Before control	1938 After 10 years control
Population	17,770	18,670
Death-rate per 1,000	31·5	21·4
Total 'sick' days	249,306	147,993
Children with malaria (spleen-rate)	60%	14·3%

To the employer these figures mean a lower sick-rate, a lower death-rate, greater efficiency in his labour force and lower cost of production. To the labourer they mean healthier and happier homes and a higher pay packet at the end of the month: 100,000 more days pay than ten years ago, on this particular group of estates. Until the new standardized returns come into general use, we shall not be able to compute the total benefit to the Indian labourer on estates; even now we can think, without the least fear of exaggeration, in terms of a gain of more than a million days wages a year.

This work has not been confined to the European-owned estates. Already several Indian-owned and Indian-managed estates have joined the local Ross Institute centres, and the Governments of Assam and Madras are co-operating with the estates to improve the health of several villages. The hope has been expressed that the European estates with their trained staffs will assist their Indian neighbours to control malaria and other diseases, to the advantage of both and the removal of what is at present a source of friction.

On Dr. G. C. Ramsay, deputy director of the Ross Institute, has fallen the heat and burden of the day. He has succeeded only because of the fine co-operation of his medical colleagues and the planters and of the support of the directors in India and at home. Sometimes the question is asked: "Can any good [medical] thing come out of Britain"? So perhaps I may be excused for expressing the opinion that the work in India is the greatest achievement in the control of malaria in the past decade; that the best of it, and there is much 'best', is worthy of comparison with the best work done at Panama or with Mussolini's great achievement in the Pontine Marshes; and in area it is vastly greater than either. Moreover, both could learn something to their advantage from India. Nor is this the whole story; for Ceylon, certain areas in British Africa, and Malaya have also fine records in preventing malaria—in Malaya begun even before Panama.

This story would not be complete without mention of how this work was made possible. The late Sir Charles McLeod, first chairman of the Ross Institute, who used to insist that "malaria, malaria" was the great enemy, and a number of his friends in the City financed the India Branch of the Ross Institute during 1930–1933, when the responsibility was taken over by the Indian Tea Association.

During this tour I visited the humble laboratory at Hyderabad in which Ronald Ross made his immortal discovery. Often I wished he could have been with me to see how mosquito reduction had spread still farther into rural areas, which as he wrote to me in 1909 he had "never dared to moot".

THE CORROSION OF FERROUS METALS

By Dr. J. Newton Friend,
Central Technical College, Birmingham

In 1916 a committee was formed by the Institution of Civil Engineers, under the chairmanship of the late Sir William Matthews, to investigate the "Deterioration of Structures exposed to Sea Action". The Department of Scientific and Industrial Research gave every encouragement and offered substantial financial assistance.

An important section of the work undertaken by the Committee is that dealing with the corrosion of iron and steel. This research has now been completed. Series of bars of fourteen different kinds of ferrous metal, measuring 2 feet in length, 3 inches in width and 0·5 inch in thickness, were exposed at various ports to sea air, to alternate sea air and wetting with sea water or spray, and to continuous immersion in the sea. Three sets were exposed at each port to each of these conditions, one for five years, one for ten and the third for fifteen years. The results obtained with the five and ten year bars have already been fully discussed in the Committee's Fifteenth Report (1935). As yet only the numerical data for the fifteen-year bars have been made public in the Committee's Seventh Interim Report (1938), the full report being temporarily held up on account of the War. It may be said at once that these last results support the earlier ones very satisfactorily, and it is the purpose of this article to mention a few of the more important practical conclusions to be derived from the numerous data now published.

The ports chosen for the exposure of the bars were Auckland (New Zealand), Halifax (Canada), Plymouth (England), and Colombo (Ceylon). These were selected as offering a wide variation in climatic conditions. Thus Colombo has a moist, tropical climate, and the total loss in weight suffered by the bars through corrosion at this port was twice that experienced at Plymouth, three times that at Halifax and nearly four times that at Auckland. Nevertheless, the relative losses among comparable sets of bars were quite analogous and thus enable us to draw many useful conclusions with a high degree of confidence.

The severe nature of the corrosion at Colombo is illustrated in Fig. 1. The steel bar *B*14 was perforated near its middle after exposure at half-tide level for ten years, whilst, after fifteen years exposure under similar conditions, bar *E*15, also of mild steel, was completely eaten in two.

At Plymouth three sets of bars were exposed to fresh-water action by immersion in the reservoir at Turnchapel for the above-mentioned periods.

In all cases the bars were maintained in a vertical position by embedding their ends in concrete, which was carefully punned into position so that no air holes or porous sections were left around the metals. The concrete proved an ideal material for the purpose. After fifteen years exposure the metal beneath the concrete was in perfect condition, except in a few cases where the concrete had cracked from one cause or another.

Moist concrete is not a perfect insulator, particularly when impregnated with salt water. Experiments carried out at Plymouth showed that minute electric currents undoubtedly passed through the frames when immersed in the sea. Hence a small amount of electrolytic corrosion was induced in some of the specimens. Most fortunately, measurement showed that this was too small to affect seriously the results, owing to the relatively great distance between the experimental bars and the re-inforcing steel rods. Had the specimens been placed appreciably closer either to one another or to the tie-bars, the effect might have been serious. This is a point worth noting in future investigations; it does not appear to have been considered hitherto.

The metals selected for study comprised: (i) three rolled irons, namely, Low Moor, Swedish and ingot irons; (ii) four carbon steels, with carbon ranging from 0·2 to 0·4 per cent; (iii) five alloy steels containing respectively 0·6 and 2·2 per cent copper; 13·6 per cent chromium; 3·75 and 36·6 per cent nickel; (iv) two cast irons, exposed in their 'skins', namely, hot blast metal *Q* and cold blast metal *R*.

In an exceptionally well-illustrated paper, read before the Institution of Civil Engineers on April 4, 1922, Sir Robert Hadfield gave a detailed account of the preparation, analysis and mechanical testing of these bars. This paper was briefly summarized in NATURE of December 30 of the same year.

As was to be expected, the high nickel steel proved, on the average, the most resistant to all forms of attack. But its high cost and special mechanical properties obviously militate against its general adoption. The chromium steel behaved remarkably well in air and in fresh-water, but in contact with sea-water it suffered such severe localized corrosion as to render it useless.

The cast irons stood up well against aerial corrosion, the cold blast metal proving slightly the more resistant. In contact with water, however, particularly sea-water, graphitization took place, sometimes working its way so deeply into the bar as to leave only a thin core of unattacked metal. This is well illustrated in Fig. 2; bars *Q*11 and *R*11, exposed to sea air at Colombo for ten years, yielded practically perfect fractures. The fractures of the other bars, exposed at half-tide level and to complete immersion in the sea, show how deeply graphitization had penetrated. The corrosion product was hard and so firmly attached to the core that it seemed impossible to remove it by mere mechanical means. Indeed, in some cases it was not until the bars had been intentionally fractured that it was realized how seriously the cast iron had been attacked. The general appearance of the bars was most misleading and, in view of this, cast iron cannot be recommended for purposes other than aerial.

In the aerial tests, Low Moor iron was found to corrode more seriously than mild steel; in fresh-water the two metals behaved pretty much alike; at half-tide level the wrought iron was slightly superior, and when exposed to complete immersion in the sea the wrought iron was decidedly superior. An answer is thus afforded to the vexed question of iron *versus* steel, in that it is shown to depend upon the type of corrosion to which the metal is destined to be exposed. Mere averaging makes the two metals appear to behave alike.

The foregoing observations clearly prove that if we wish to know which particular metal to choose as most suitable for resisting corrosion, the particular type of corrosion must be specified. No metal is equally resistant to all types of corrosion, and so-called acceleration tests, carried out under conditions different from those to which the metal is destined to be exposed, may easily yield most misleading results. I had already pointed this out in 1911 in my book "The Corrosion of Iron and Steel" (Longmans), p. 276, and the conclusion arrived at then now receives overwhelming support.

An interesting feature of the research is afforded by the various ways in which the different metals have been attacked under the different conditions of exposure. Thus, for example, the surfaces of most of the bars exposed to sea air alone were covered with innumerable *pocks* of varying degrees of fineness or coarseness according to circumstances. The wrought irons exposed to sea-water were usually covered with furrows or narrow channels running down the full length of the bar, that is, in the direction of rolling. The appearance was

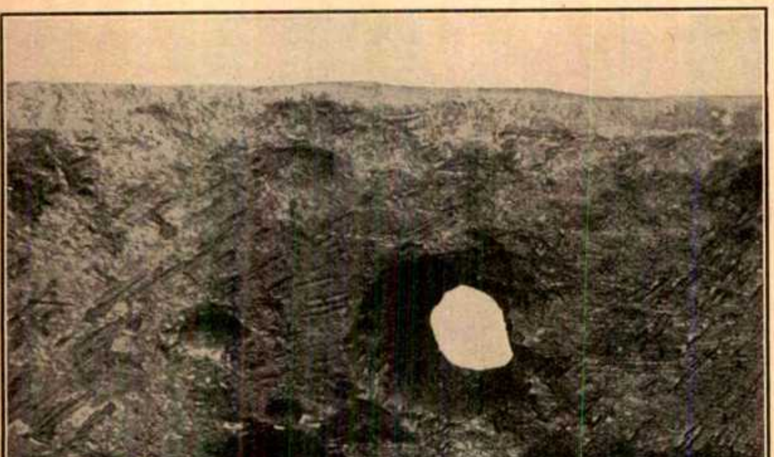


Fig. 1.

MILD STEEL BAR EXPOSED FOR TEN YEARS AT HALF-TIDE LEVEL AT COLOMBO.

characteristic and a mere glance enabled one to distinguish between the wrought irons and steels.

Whilst the wrought irons had been exposed in a cleaned condition, that is, ground free from scale, some of the carbon steels had likewise been cleaned, whereas others were exposed with their mill scale still adherent. It is instructive to contrast the behaviour of the steels under these two conditions. The following case is typical. Two mild steel bars, *A* 18 and *E* 18, of the same metal were exposed to complete immersion in the sea at Colombo for fifteen years. Bar *A* 18, which had been cleaned before exposure, was fairly uniformly attacked and its surface relatively smooth. Bar *E* 18 had been exposed with adherent scale, some of which could still be seen clinging to the metal. But where the scale had broken away, serious localized corrosion had occurred, analogous to that on *B* 14 (Fig. 1). Some of the pits penetrated more than halfway through the bar. Had two such pits happened to coincide on opposite sides of the bar, as did occur with *B* 14, the bar would have been perforated and virtually destroyed. The two bars had lost practically the same amounts in weight. Clearly it is most desirable to remove scale from steels destined to be exposed to sea action.

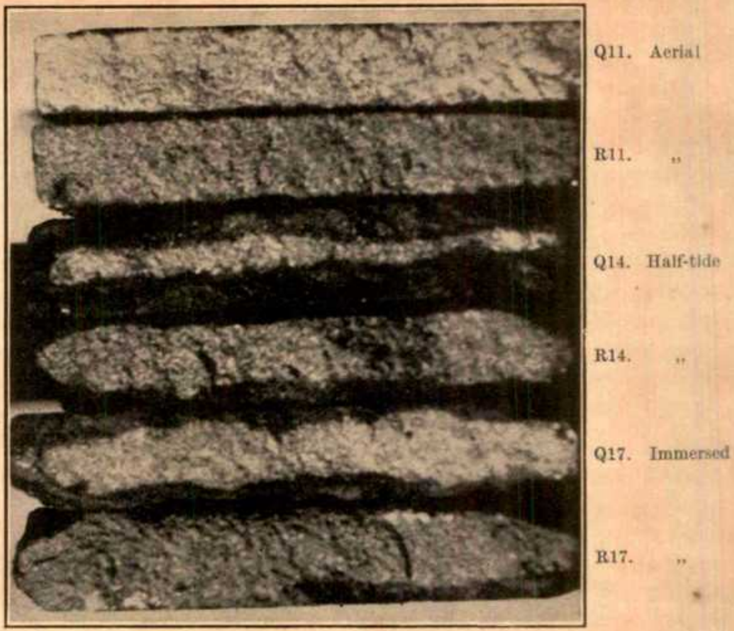


Fig. 2.

CAST IRON BARS EXPOSED FOR TEN YEARS AT COLOMBO.
Q = HOT BLAST; R = COLD BLAST.

In the case of the bars merely exposed to sea air, it was noted that the cleaned bars usually lost appreciably *less* in weight than the others—a result that was not expected. The differences in the depths of pitting were less pronounced, it is true, but such advantage as did occur lay again in favour of the cleaned bars.

The general progress of the corrosion of many of the bars exposed at half-tide level and to complete immersion in the sea was often rendered more complex by the presence of shelly fauna. Isolated shelly growths appeared to stimulate corrosion much in the same way as isolated patches of scale. Dead shell-fish seemed particularly deleterious, probably owing to the chemical activity of the organic decomposition products. At Auckland the bars were covered with a thick layer of shelly fauna which appeared to exert a mechanical protective action on the underlying metal. The fauna consisted mainly of barnacles and oysters; the former covered the bars whilst the oysters rested on top of the barnacles. In one case only was an oyster found to be in direct contact with the metal, and the position it had occupied was faintly discernible, after cleaning, as a slight depression on the steel.

Turning now to the alloy steels, it may be mentioned that the presence of 0·6 per cent copper greatly enhanced the resistance of the steel to sea air and to fresh-water. In contact with sea-water, the effect either way was small. Increasing the percentage of copper to two did not, in general, effect much improvement; indeed, in some cases it seemed disadvantageous. Any added cost thereby entailed would certainly not be justified.

The addition of 3·75 per cent of nickel effected a very great reduction in the corrosion of the bars exposed either to sea air alone or to fresh-water. At half-tide level and when completely immersed in sea-water, the nickel steel still proved superior to the copper steel, but less markedly so.

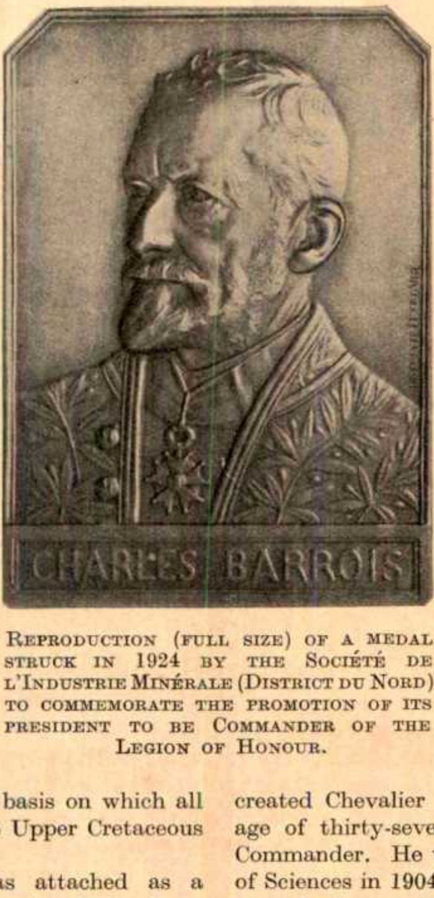
One point in connexion with the alloy steels would appear to be important, namely, that in general they show a greater tendency to localized corrosion or pitting than do ordinary carbon steels in contact with sea-water. Mention has already been made of the severe localized corrosion suffered by the chromium steel.

The full report of the Committee, when published, will contain valuable material. In a brief summary such as this, it is obviously possible to deal with only a few of the interesting results obtained. The present chairman of the Committee is Mr. W. T. Halcrow, and it is to be sincerely hoped that this valuable work may be continued as soon as circumstances permit.

OBITUARIES

Prof. Charles Barrois, For.Mem.R.S.

Among French geologists whose names are well known in England, that of Charles Barrois stands high with those of the great pioneers and leaders of geology which France has produced. For this there are many reasons, for not only were his scientific attainments of the highest order, but also he was always a staunch Anglophile and he had made himself known in his early days by his outstanding work in England itself.



Reproduction (full size) of a medal struck in 1924 by the Société de l'Industrie Minérale (District du Nord) to commemorate the promotion of its president to be Commander of the Legion of Honour.

Charles Barrois was the son of one of the great industrial families of the north of France, and it was natural that he should continue in the family business. As a young man he had always taken a great interest in geology, and when he came to England to study English methods of manufacture and become a fluent linguist, he found that his interests lay much more in geology than in the mills, with the result that he spent all his spare time studying his hobby.

About this time, at the age of twenty, Barrois decided to devote himself to science, and in 1871 he joined Prof. Jules Gosselet at the University of Lille in the newly formed Geological Department. Five years later he was granted a doctorate of science at the Sorbonne for his work on the Upper Cretaceous strata of England and Ireland. In this great work he showed that the palæontological zones recently established in France could be applied equally well in Britain. This work forms the basis on which all the subsequent zonal work on the Upper Cretaceous in Britain has been built.

About this time, Barrois was attached as a *collaborateur principal* to the Service de la Carte Géologique. The area which fell to him to investigate was the highly complex area of the Armorican Massif. His name appears on many of the sheets of the geological maps of Normandy and Brittany. Besides the maps themselves he wrote numerous papers, some descriptive and some of considerable theoretical importance, based on his studies of this highly complex area. Although essentially a stratigrapher, he wrote on such problems as the emplacement of granites and general petrographical problems. In the later years of his life he frequently returned to this area to revise his earlier maps.

It is natural that since his university was in the neighbourhood of the coalfields of the Nord and Pas-de-Calais, Barrois should have joined Gosselet in applying his geological knowledge to the problems of that complex field. As knowledge accumulated and the correlation of the various beds and seams was established, the structure of the field was elucidated. These studies led to the founding of the Musée houiller de l'Université de Lille in 1908, with models of many of the chief collieries made on plates of glass giving a wonderful three-dimensional picture of the extraordinary complex structures revealed in the process of mining.

In 1919, Barrois, with Prof. P. Pruvost, his pupil and successor to the chair of geology at Lille, carried the knowledge learned in the north of France to a study of the coalfields of Lorraine and the Sarre. In 1902 he succeeded Gosselet as head of the Geological Department.

Besides the work in France and England, Barrois worked in Spain and was a well-known member of numerous geological excursions and congresses in many parts of the world.

During the War of 1914–18, Barrois felt it his duty to remain with his collections in Lille and spent four years there under the German occupation. During this period his old master, Gosselet, died; now again under the shadow of war, Lille has lost another of its great geologists.

Prof. Barrois received many honours. In France he was created Chevalier of the Legion of Honour at the age of thirty-seven and in 1923 was promoted to Commander. He was elected to the Paris Academy of Sciences in 1904 and became its president in 1927. Outside France he was also honoured; he was a foreign member of the Royal Societies of London and Edinburgh, and he was senior foreign fellow of the Geological Society of London, receiving its highest award, the Wollaston Medal, in 1901. He was foreign member of many societies and academies, of the United States, Belgium, Spain and Germany, and he was also a member of the Pontifical Academy.

Barrois died at the age of ninety-one on November 5, 1939, in Normandy, but was buried at Lille, where the funeral service, conducted by the Cardinal Archbishop of Lille, was held in his parish church of Saint-Maurice-des-champs, a suburb of Lille.

The Rev. F. C. R. Jourdain

THE death of the Rev. F. C. R. Jourdain at his home in Southbourne, Bournemouth, on February 27 at the age of seventy-four is a grievous loss to European ornithology. Jourdain was generally recognized as the leading authority on the breeding biology of the birds of the Palæarctic region, and the accuracy and comprehensiveness of his knowledge of the subject has not been equalled by any ornithologist past or present. His great collection of the eggs of Palæarctic birds was formed in a truly scientific spirit unfortunately too rare among collectors of eggs, and its value for comparative purposes is unrivalled, so that it is greatly to be hoped that it may be preserved intact. But although Jourdain was an enthusiastic collector, he was intensely interested in every aspect of the breeding biology of birds, and his mastery of his subject was based on a happy combination of wide field experience and an encyclopædic knowledge of the literature. For many years he had made a collecting expedition almost annually, visiting in this way almost all of the more ornithologically interesting parts of Europe (excluding Russia) and North Africa, and these trips resulted in a number of valuable faunistic papers in the *Ibis* and elsewhere.

Jourdain tabulated and classified with amazing industry the whole mass of data on the breeding of Palæarctic birds from the extensive literature, supplemented by his own experience and that of a wide circle of correspondents, and his sections on breeding habits in the "Handbook of British Birds", now appearing, are marvels of concise and exact information which could have been written by no other ornithologist. Moreover, the enormous increase in detailed knowledge of the subject recorded in the "Handbook" as compared with its smaller predecessor, the "Practical Handbook of British Birds" (1919–23) is in very large measure directly due to the stimulus given to further investigation by his orderly systematization of the facts then known in the older work. He was also responsible for the sections on food, distribution abroad, and (jointly with me) on display. It is sad that he did not live to see the completion of this crowning achievement of his life's work in ornithology; but it is gratifying to know that his sections in the final volume will be completed mainly from his own comprehensive notes. References to the various other standard works on British ornithology in which he collaborated and to his many notes and papers on British birds will be found in the longer notices in *British Birds* or the *Ibis*.

Jourdain was an unsparing critic of inaccuracy in matters of fact with regard to birds, or support of theories which he believed to be contrary to the evidence, and his frequently witty, but withering style in controversy made him enemies in some quarters. This fighting trait was very characteristic, but the reputation which it gained him gave many a quite wrong impression of his real character. This was much more truly displayed in his unfailing willingness to assist and advise every serious student of birds who asked for his help, and above all in his constant and generous encouragement of the younger generation of ornithologists, which found full scope in the years following the War of 1914–18, when he was rector of Appleton, near Oxford. The prominent part played by Oxford in recent years in the organized study of the bionomics of birds, now centred in the Edward Grey Institute of Field Ornithology, may be traced directly to his influence, and this is not the least of his contributions to the scientific study of birds to which he devoted his life.

B. W. TUCKER.

Mr. E. E. M. Joyce

ERNEST E. MILLS JOYCE, who died on May 2 at the age of sixty-five, was one of the remarkable group of naval ratings chosen by Captain Scott for the National Antarctic Expedition of 1901, and his name will live with those of Frank Wild and Edgar Evans among the sailor explorers of his time.

On the *Discovery* expedition Joyce developed qualities of independence and self-reliance which led Sir Ernest Shackleton to persuade him to leave the Navy, where he was a chief petty officer, and to join the *Nimrod* expedition of 1907. To him Shackleton confided the responsible task of laying out the depot at the Bluff in a fixed position, with provisions for the last lap of the homeward journey. This was done after Shackleton's departure on his great southern journey, and the success of the return journey was due to the perfect performance of this duty. During the winter of waiting at the base Joyce became skilled as a printer and he produced "Aurora Australis", the only book ever printed and bound in the Antarctic regions. This book is now one of the rarest finds for any collector.

Joyce was employed by Sir Douglas Mawson when equipping the *Aurora* expedition in 1912 to select Greenland dogs in Denmark and convey them to Tasmania. He remained in Australia until 1914, when Shackleton called on him to undertake the transport arrangements of the Ross Sea branch of that Imperial Trans-Antarctic Expedition which he had planned in a too optimistic spirit. The *Aurora*, under the command of Captain Aeneas Mackintosh, took the party to Macmurdo Sound, in order to lay out a line of depots as far as the Beardmore Glacier with supplies for Shackleton and his party, who were expected to cross the Antarctic plateau from the Weddell Sea by way of the South Pole. The captain, who was in charge, and other members of the sledge party were overcome by scurvy on the way to the Beardmore Glacier, and Joyce assumed command. The sick men had to be carried on the sledges during the return and one died; but Joyce, under tremendous difficulties, laid out the depots exactly as planned, and if Shackleton had been able to land in the Weddell Sea he would have found his last stage easy. Joyce's enormous strength and ruthless determination enabled him to achieve this feat and to bring all but one of his party safely to the advanced base. He has given a grim but vivid description of this terrible journey in his "South Polar Trial", published in 1929.

HUGH ROBERT MILL.

Prof. Edoardo Maragliano

PROF. EDOARDO MARAGLIANO, the famous Italian physician, whose death recently occurred in his ninety-first year, was born at Genoa on June 1, 1849. He received his medical education at Naples, where his principal teachers were Salvatore Tommasi and Arnaldo Cantani, and qualified in 1870 with a thesis "of exceptional merit" on some diseases of the nerve centres. He started his career by being assistant to Prof. Enrico de Renzi at Naples for a few years, and then became lecturer in general pathology at Genoa from 1877 to 1881. He was then elected professor of clinical medicine at Genoa, and held this post for forty-three years.

Maragliano succeeded in making his clinic at Genoa one of the most celebrated in Italy, and it was attended by practitioners from all parts of the country and abroad. Though he always subordinated laboratory examinations to clinical observation, he established a number of laboratories in connexion with his clinic to deal with the various problems connected with clinical medicine. His excellence as a teacher is shown by the fact that eight of his pupils afterwards obtained professorial chairs in various Italian universities.

Maragliano's writings ranged over all fields of internal medicine, including pneumococcal infections, cholera, and disorders of the blood and heart, but the disease in which he was most interested was pulmonary tuberculosis, and particularly prevention of the disease by a vaccine containing dead bacilli. Although the value of this method has not been proved, he did good work in conducting an active campaign against tuberculosis in Italy and he was largely responsible for a decline in its prevalence.

For seven years Maragliano was president of the Medical Faculty of Genoa and for more than ten years rector. In 1900 he was elected senator of Italy. His other activities consisted in the foundation of the Genoa Academy and an Italian Society of Internal Medicine in conjunction with Cantani and Bacelli, as well as of a post-graduate school for tuberculosis at Genoa which was attended by numerous practitioners from all parts of Italy. He was also founder of *Archivio Italiano di Clinica Medica* (1893), *Annali dell' Instituto Maragliano per lo Studio e la Cura della Tubercolosi* (1904) and *Archivi di Biologia* (1924). During the War of 1914–18, in which he was given the rank of major-general, he was appointed director of the military clinic at Padua.

J. D. ROLLESTON.

Mr. W. S. Furneaux

MANY a school-boy of forty years ago and many younger school-boys and former pupils will be sorry to hear of the death of W. S. Furneaux. He had the knack of writing just the sort of succinct and well-illustrated practical book which stimulated the young collector to hunt for spoils and afterwards to pore over the naming of them; and his publishers aided and abetted with that profusion of coloured plates which added attractiveness to utility. "The Outdoor World" (1893), one of the best of the series, was followed by accounts of "Life in Ponds and Streams" (1896), "The Sea Shore" (1903), and "Field and Woodland Plants" (1909), and these and his other works, such as "British Butterflies and Moths" (1894), must have opened up new worlds for young naturalists of two generations. It says something for their quality that they are still amongst the best of British books for their purpose.

Furneaux was born at Devonport in 1855, and was educated at Cheltenham College. Eventually he came to London, where he taught science successfully and with appreciation for many years, first as lecturer at the Pupil Teachers' Training Centre and principal of the Science and Art Evening Institute at Peckham, and later as lecturer in the Teachers' Day Training College at Islington. He retired in 1913 and settled in Felbridge, Sussex, and there his own love of Nature was exercised in the skilful and enthusiastic way in which during the course of years he transformed a bare meadow into a secluded woodland retreat.

He died on April 9, 1940, in his eighty-fifth year.

J. RITCHIE.

Dr. W. E. Sumpner

THE death took place on May 8 of Dr. W. E. Sumpner, principal of the Birmingham Technical College during 1895–1930, in his seventy-sixth year.

He was appointed when the College (or School as it was originally called) was only four years old, and it was owing to his work and vision that it became such an important institution in this great industrial centre.

Sumpner was primarily a physicist and electrical engineer, and he was well known in scientific circles. In his early days he was connected with the City Guilds of London. In 1885 he took first-class honours in both mathematics and physics, and four years later he took the London D.Sc. He was then appointed fellow of University College, London, and fellow of the City and Guilds Institute. He was also fellow of the Physical Society, serving as vice-president for a time. For some of us in Birmingham perhaps he was best known and regarded as the genial president of a small scientific symposium known as the R^3, founded originally by the late Prof. Poynting, of the University of Birmingham, for those teaching science in the city. He married in 1901 Miss Lucy Weekes, who survives him with a son and a daughter.

J. H. REYNOLDS.

WE regret to announce the following deaths:

Prof. W. Blackadder, Jackson professor of engineering in the University of Aberdeen, on May 14, aged sixty-one.

Mr. E. R. Gunther, zoologist to the "Discovery" Committee, aged thirty-seven.

Prof. J. H. Muirhead, F.B.A., emeritus professor of philosophy in the University of Birmingham, on May 24, aged eighty-five.

NEWS AND VIEWS

Scientific Advisory Committee on the Nation's Food

THE Lord Privy Seal, as chairman of the Food Policy Committee of the War Cabinet, has appointed a committee "to consider and advise upon problems of national food requirements and of home food production with special regard to the shipping and foreign exchange likely to be available for imports of food and animal feeding-stuffs, and the labour and other resources likely to be available for home production".

The committee has been constituted as follows: *Chairman*, Sir William Bragg, president of the Royal Society and director of the Royal Institution; *Deputy Chairman*, Sir Alan Anderson; *Members*, Prof. A. W. Ashby, professor of agricultural economics, University College of Wales, Aberystwyth; Prof. E. P. Cathcart, F.R.S., regius professor of physiology, University of Glasgow; Dr. Henry Clay, formerly professor of social economics, University of Manchester; Prof. F. L. Engledow, F.R.S., professor of agriculture, University of Cambridge; Mr. W. Gavin, agricultural adviser to the Ministry of Agriculture and Fisheries; Sir Edward Mellanby, F.R.S., secretary of the Medical Research Council; Sir John Boyd Orr, F.R.S., director of the Rowett Research Institute, Aberdeen; Prof. J. A. Scott-Watson, professor of rural economy, University of Oxford; *Secretary*, Prof. D. M. S. Watson, F.R.S., Jodrell professor of zoology and comparative anatomy, University College, London, and member of the Agricultural Research Council.

FOR purposes of economy, the sections "Seventy Years Ago" and "Points from Letters" will be suspended after the termination of the present volume of NATURE, that is, June 29.

The Editors are particularly anxious to maintain the amount of space devoted to the more important sections of the journal. This applies especially to the correspondence columns; and, here, contributors are again asked to collaborate by reducing their communications to the absolute minimum. Letters should not exceed five hundred words in length, which corresponds to a column of text.

Monthly supplements of Short Reviews will also be suspended.

Chair of Physics at Sheffield: Dr. W. Sucksmith, F.R.S.

DR. W. SUCKSMITH, reader in magnetism in the University of Bristol, has been appointed to the chair of physics in the University of Sheffield. Dr. Sucksmith was educated at Hipperholme Grammar School and the University of Leeds where, after four years of service with the Army in the War of 1914–18, he graduated with first class honours in physics in 1921. He then joined the staff of the University of Bristol as assistant lecturer in physics, and was appointed lecturer in 1924 and reader in magnetism in 1939. He was awarded the D.Sc. degree of the University of Leeds in 1930, and has been elected a fellow of the Royal Society this year. Dr. Sucksmith is particularly distinguished for his work in experimental magnetism. Following a determination of the gyromagnetic ratio for ferromagnetic substances by the direct measurement of the mechanical rotation which accompanies magnetization, carried out by Chattock and Bates at Bristol, he confirmed their results with a null method. He later extended his measurements to deal with paramagnetic substances. This required experimental skill of a very high order, as the measurements were very much more difficult than those with ferromagnetic substances. In the course of this work it was necessary to measure the susceptibilities of paramagnetic oxides, and to this we owe the design of the Sucksmith ring balance, which has proved useful in many researches.

During the session 1933–34 Dr. Sucksmith held a Rockefeller fellowship at the Federal Technical College in Zurich, where he measured the gyromagnetic ratio for a series of nickel-copper alloys with low Curie points at temperatures above the latter, using the technique previously employed with paramagnetic oxides. Dr. Sucksmith has also made substantial contributions to our knowledge of the specific heats of ferromagnetic substances and of the magnetic properties of single crystals of nickel. More recently he has been engaged on experiments on the magnetic properties of ferromagnetic substances at high temperatures and on the saturation intensities of magnetization of a large number of ferromagnetic alloys, in which his ring balance has again been put to good use. Since 1937 he has been a member of the Permanent Magnet Sub-Committee of the Electrical Research Association.

Prof. S. R. Milner, F.R.S.

WITH the retirement in September of Prof. S. R. Milner, F.R.S., from the chair of physics, the University of Sheffield will lose the services of an eminent man of science and of an outstanding personality, who, during the past forty years, has been untiring in his efforts alike for the advancement of science, for his students, and for the University. A Yorkshireman by birth, Milner spent his early years in Retford, where he attended the King Edward VI

School. He then became a science student at University College, Bristol, and graduated from there in 1895. He spent two post-graduate years as an 1851 Royal Exhibition Scholar working under the late Prof. A. P. Chattock, for whom he has always retained warm feelings of admiration and affection, and a third year under Prof. Nernst at the Institut für physikalische Chemie in the University of Göttingen. During 1898–1900 he was a demonstrator in physics at the University of Manchester, and he recalls with pride that Sir Arthur Eddington was one of his students there. Milner left Manchester to take up a lectureship in physics at Firth College, later the University of Sheffield, under Prof. W. M. Hicks, who was successively principal of the College and the first vice-chancellor of the University, so that much of the work and organization of the department fell to Milner's lot. During the War of 1914–18 he served as assistant radiographer to the Third Northern General Hospital until 1917, when he was appointed acting professor of physics, on Prof. Hicks vacating the chair. Since 1921 he has been professor of physics, and in 1922 he was elected to the fellowship of the Royal Society.

In his research activities, Prof. Milner has shown himself to be a physicist in the widest sense, his researches having ranged over many fields, only some of which can be mentioned here. His earliest work was on the thermal conductivity of water (with Prof. Chattock). Later work was concerned with interference phenomena, with the non-reversible character of the formation of soap films, with the electric discharge in mercury vapour (in which connexion he discovered the principal series of mercury), and with the mechanism of the spark discharge, involving the analysis of lines in a rotating mirror and the characteristics of the oscillatory spark. By his pioneer work on the theory of strong electrolytes he anticipated the work of Debye. His more recent work has been concerned with the properties of the electromagnetic field in four dimensions, especially the theory of tubes of force and action in their four-dimensional aspects, and with the properties of Eddington's wave matrices. An experimentalist of no mean order, Prof. Milner is also a self-made theoretical physicist, so that his approach to theoretical work is always characterized by the physical rather than the purely mathematical outlook. Primarily due to this fact he has the rare ability of presenting intelligibly abstruse advances in modern physical theory to a general scientific audience. Many of his old students now occupy prominent positions in the scientific world, and all who know him or his work will join in wishing him many years of happiness and good health in his retirement.

Dr. W. L. H. Duckworth

THE election of Dr. Wynfrid Laurence Henry Duckworth to be Master of Jesus College, Cambridge, which was announced on May 28, is a well-deserved recognition of a devotion to the service of his College and University which is well-nigh lifelong. Dr. Duckworth, who is reader in anatomy, went to the University as a scholar of Jesus College, after receiving his earlier education in Birkenhead and at Dinan, Brittany. He graduated with first-class honours in both parts of the Natural Sciences Tripos in 1892–93, and during 1898–1920 was University lecturer in physical anthropology. His laboratory demonstrations and organization and arrangement of the museum specimens which came within his province contributed markedly to placing the Cambridge school in a unique position in anthropological studies; while so long ago as 1902, Dr. Duckworth's merit as an original thinker and teacher in anthropology were widely recognized on the publication of his two books "Morphology and Anthropology" and "Studies from the Anthropological Laboratory" (Cambridge). In the same year Dr. Duckworth was invited by a committee of the British Association to join the archæological expedition then excavating in Crete, for the purpose of investigating the racial characters of the ancient and modern inhabitants of the island. The report which he eventually produced is still of standard authority on this question. Dr. Duckworth, who was born on June 5, 1870, represented his University on the General Medical Council during 1923–26.

Colonial Development and Allied Co-operation

CERTAIN matters of no little moment in relation to scientific research and its application to problems of Colonial development were mentioned in the debate on the second reading of Mr. Malcolm MacDonald's Bill to which it was not possible to refer in NATURE of June 1 (see p. 853). Mr. MacDonald had stressed the facilities which the Bill would afford not only in erecting buildings for clinics, hospitals and schools, to which grants under the existing Colonial Development Act are confined, but also in assisting their maintenance after erection, as well as steadily increasing the opportunities for medical and veterinary research and of health measures of all kinds. The importance of the assistance in maintenance was more fully brought out by Sir Francis Fremantle, who stressed its importance in relation to education, which he urged should be directed towards the objects which appealed to the natives, namely, agriculture and health. His experience as a sanitary officer in Mesopotamia during the War of 1914–18 brought him into relation with various races whose intelligence—even of the most primitive of them—in malaria prevention after even a short course of instruction had astonished him. After referring to the results and needs of research on leprosy, he went on to point to the achievement on exiguous resources of small hospitals and clinics in Zuzuland. In research he urged that a great deal could be done in regard to the native population, especially in the matter of psychology.

An important aspect of the problems to which research in Africa, for example, will be directed was presented by Sir Jocelyn Lucas, who, in speaking of progress in the study of tropical diseases, stressed the importance in this, as well as in other respects, of co-operation with our French Allies. How far the War has fostered co-operation between French and

British medical and scientific men is indicated by "Medicus M.P. in France" (*Lancet*, June 1, p. 1031), who speaks of the constant consultations taking place between medical officers of divisions of the two forces and the meetings of French and British consultants, including distinguished civilians, at G.H.Q., at which views are exchanged, leading with numerous other facilities to a far greater degree of co-operation than during 1914–18. This readiness to co-operate and unity of purpose, it may be anticipated with no little confidence, will inspire the co-operation in Colonial administration in the future upon which the two Governments have agreed. Now that the resources of the Belgian Congo and Mandated Territory, upon which the Belgian Government has lavished expenditure, have been placed at the disposal of Belgium's allies, a valuable opportunity has arisen for laying the foundations of future research and co-ordinated action.

Blood-Group Tests and Paternity

In view of the application of blood-group tests in medico-legal problems involving disputed blood-relationship, it is interesting to note results of the test in a series of fifty cases which have been recorded by Dr. David Harley and Dr. G. Roche Lynch (*Lancet*, May 18, 1940). Most of the cases were affiliation cases; in these, as is well known, the blood test, while not establishing paternity, does eliminate false accusation by establishing non-paternity, the expected rate of establishment on the assumption that all men are falsely accused being approximately 32 per cent. In the present series, non-paternity was established in eight cases, or 16 per cent, a figure which suggests that about half the men were falsely accused, while half were in fact the fathers. The authors point out that while the percentage is not likely to be so high in the 5,000 affiliation cases heard in England and Wales in the course of a year, since in many of them paternity is not in dispute, but merely the amount of compensation, yet the fact that an appreciable number of men prefer to go to prison rather than pay suggests that the number of false accusations is by no means negligible. With improvement in the technique of identifying sub-groups, the utilization of these factors should add to the value of the test in such proceedings by raising the percentage of exclusions possible.

National Collections in London or in the Country?

A matter of very great importance to scientific workers in Great Britain and throughout the world is raised by Dr. Percy R. Lowe in an article discussing the threatened removal of the ornithological collections from the British Museum (Natural History) to Tring (*Museums J.*, 49; May 1940). It is there stated that "the Trustees of the Museum seriously contemplate transferring the national ornithological collections from South Kensington in London to Tring in Hertfordshire". That would indeed be a serious step, for no expert studies bird skins without using the books referring to the group upon which he is working. So that the ornithological library would have to follow. But many bird papers appear in journals not specifically devoted to ornithology; would the series of these journals also have to go, or would the expert be left in the lurch? That seems to be a problem not easily solved; Dr. Lowe discusses others. But indeed the proposal bristles with so many difficulties that it may be taken for granted that the Trustees will seek advice from scientific workers who are accustomed to study ornithological or other systematic collections, and will make no decision even for the future without the fullest inquiry and consultation.

The British Pharmacopœia: Emergency Monographs

The need for an addendum to the "British Pharmacopœia" which is now ready for official publication was dictated by war-time circumstances which deprived Great Britain of unfettered access to supplies of cod liver oil and olive oil and made it desirable to sanction the use of substitutes for both. The outstanding new monograph in the Addendum is on *oleum vitaminatum*, a vitaminized oil which is a solution of vitamins A and D containing 1,000 units of vitamin A activity and 100 units of antirachitic activity (vitamin D) in 1 gm. It is clear that the object of the Pharmacopœia Commission was to provide a standard for a substitute for cod liver oil which, in respect of its vitamin contents, should approximate to the natural product. The vehicle for the vitamins may be "a suitable vegetable oil" the choice of which is left to the manufacturer, with the suggestion that arachis oil would answer the purpose at least as well as any other. Provided the preparation responds to the characters and tests for purity laid down in the monograph, vitaminized oil may consist, alternatively, of a suitable fish-liver oil, or blend of fish-liver oils, thus allowing to commercial firms a generous latitude which is justifiable, and indeed advisable, in a time of emergency. Of the nine other new monographs in the Addendum, seven are related to the cod liver oil problem; they include standards for concentrated solutions of vitamins and for emulsions of cod liver oil itself and its substitute.

The only new monograph which is unrelated to cod liver oil is that on tetanus toxoid, which is officially described as "tetanus toxin, the sterile filtrate of a culture on a suitable medium of *Clustridium tetani*, or material derived therefrom, the specific toxicity of which has been completely removed by the action of chemical substances in such a manner that it retains efficient properties as an immunising antigen". Tetanus toxoid may occur as a simple solution of tetanus toxin or as alum-precipitated tetanus toxoid. The Addendum amends five monographs of the Pharmacopœia. The object of the alterations in some cases, namely, liniment of camphor and compound ointment of mercury, is to authorize the use of arachis oil, cottonseed oil or sesame oil in place of olive oil in making these preparations. In the case of capsicum ointment, the use is sanctioned of a simple ointment prepared with yellow soft paraffin in place of the present base which contains lard. A new formula is presented as a standard for tannic acid ointment. Five appendixes to the Addendum revise existing directions for as many processes; they relate to the determination of (1) ultra-violet absorption, (2) iodine value, (3) unsaponifiable matter in fixed oils and fats, (4) aldehydes or volatile oils, and (5) the assay of vitamin A.

Biological Films

THE Gaumont British Instructional Films Bureau has recently added some interesting biological films to its already extensive collection. "Climbing Plants" portrays clearly the many different devices for climbing adopted by plants in their struggle for existence, including 'scramblers', thorn, petiole and aerial root climbers, as well as types that climb by means of tendrils and stems. The photographs of circumnutation in the bean seedling are as excellent as the rest of the film. In "The Swan", the photographer has captured some entertaining 'shots' of the famous swannery at Abbotsbury, near Weymouth. Courtship and breeding are carefully presented, as well as pleasant recordings of cygnet development. "The Life-Story of a Fern" includes photographs of royal, hart's-tongue, male and bracken ferns, indicating methods of spore production and liberation. In this film some informative pictures of fertilization processes in the ferns are particularly noteworthy.

"The Emperor Moth" describes the complete life-cycle of the insect from the egg to the emergence from the pupal case. The value of this film, as of many other insect films, is that the activities and development of the insect over a period of weeks may be seen as a coherent picture within a few minutes. In "Marshland Birds" various island builders like the dabchick, great crested grebe, the coot, swan and moorhen are seen in various stages of their life-history, as also are shore-builders such as the snipe, wild duck, bittern, yellow wagtail, bearded tit, reed warbler and heron. Photographs of predators like the short-eared owl and the harrier are included in order to introduce an ecological concept. In this film the photographer has secured many pictures which must be ranked well outside the usual. The appearance of these five films bears witness to the continued technical progress that is being made in the production of biological films.

Observation of Chimpanzees

AN experimental laboratory for the observation of behavioural development and adjustment, growth and maturation of chimpanzees has recently been established at the Yale Laboratories of Primate Biology, Orange Park, Florida. Infants are to be separated from their mothers at birth and reared under controlled conditions as subjects of a special research by Dr. Henry W. Nissen, assistant director. Up to March 1940, Prof. R. M. Yerkes records (*Science*, 91; April 5, 1940), 34 infants have been born in the colony, which contains 27 individuals of known birth-date and recorded life-history out of a total population of 47, ranging in age from four days to twenty-seven years. Several of these chimpanzees have resided in the colony for 8–14 years. Though the normal life of this great ape in captivity has not been determined, it is indicated that the reproductive life may exceed thirty years, while probably in favourable conditions the individual may live for fifty years. The average interval between generations in the breeding colony is almost exactly nine years.

With regard to the special problems of behaviour, it may be noted that of two primiparous mothers, neither accepted nor cared for their infants at birth. Each behaved as if surprised and bewildered, while lacking suitable, ready-to-hand patterns of behaviour for the novel emergency. Nor did either consume the afterbirth. By contrast, multiparous mothers usually eat at least part of the afterbirth and almost invariably treat the new-born infant as a familiar object, handling it skilfully and ensuring its welfare. The structurally determined maternal behaviour of the primiparous chimpanzee is importantly supplemented by acquisitions resulting from individual reproductive experience and also by social tradition.

Control of Weeds and Grassland Experimentation

THE Imperial Bureau of Pastures and Forage Crops, Aberystwyth, has recently published three new bulletins. No. 27, "The Control of Weeds" (7*s.* 6*d.*), is a symposium dealing with the various aspects of the problem as it occurs in different parts of the world, particularly in the British Commonwealth and the United States. Increasing attention is being paid to this question; extensive research work on cultural, chemical and biological means of control is in progress, and important results are already available. The practices characteristic of each country make interesting comparison. The outlook regarding chemical measures of control, for example, is very different in the United States and Germany, stress being laid on the value of cultural methods in the latter case. In Australia and New Zealand biological means have been used, with spectacular success in the eradication of prickly pear in Australia. Poisonous weeds are the subject of an article from South Africa, while Canada's contribution is chiefly ecological.

Bulletin No. 28 (2*s.* 6*d.*) describes the "Technique of Grassland Experimentation in Scandinavia and Finland". This includes both the technique for the quantitative measurement of grass production and that of stock-grazing trials. The methods of grassland analysis are chiefly contributed from Denmark and Sweden, while the grazing experiments described were carried out in Norway and Finland. Bulletin No. 29 (5*s.*) is entitled "Grassland Investigations in Australia". This publication may be regarded as a continuation of Bulletin No. 14 issued in 1934, which dealt with a similar subject. The enormous variation in climate naturally raises very diverse problems in the different parts of the country, but in general the pasture investigations cover two main features, natural pasture maintenance and regeneration, and the treatment of sown pastures, together with the problems of the winter and summer rainfall zones.

Fifteen special articles are included in this bulletin, as well as brief abstracts of recent publications on grassland in Australia.

Power Development in Turkey

ENERGETIC steps are now being taken by the Government to open up the market in the south-east corner of Europe to British industry. According to the *Electrical Times* of May 2, one of the first results of this active trade policy was shown by the recent announcement of the signing of a contract between the Turkish Government institution known as the Eti-Bank and the Metropolitan-Vickers Electrical Co., Ltd., which has a value of approximately one and a half million pounds. A few details of the contract are available. It covers the electrification of a large and important area, including the construction of a power station at Catalagzi on the Anatolian coast of the Black Sea. One of the main objects of the scheme is the provision of electric power for the modernization and expansion of the Turkish coal industry, and the site of the power station has been chosen for its proximity to the Zonguldak coal basin, from which the station fuel will be derived. The present contract includes the building and equipment of a 60,000 kw. steam power station, and the provision of switchgear, overhead lines and three substations for a transmission system about 16 km. in length. Provision is to be made for the extension of the scheme at some future date.

The initial generating plant will consist of three 20,000 kw. turbo-alternator sets, to operate at 3,000 r.p.m., with Metrovick central flow condensers and four-stage feed-heating, incorporating low-pressure evaporators for make-up supply. Sea-water will be used for cooling and will be supplied from a separate pump-house to be constructed on the shore. The main alternators will generate at 11,000 volts; and each set will include a 1,500 kw. house-service alternator. A 375 kw. Diesel engine set will also be provided for stand-by service to the station auxiliaries. Transmission to the substation will be at 66,000 volts, the station output being stepped up to this voltage in an outdoor transformer and switching station adjoining the power station and controlled from an indoor controlled board. The main transformers will be 25,000 kva., 11/16 kv., 3-phase units. The equipments of the substations will include nine 6,400 kva., 66/15 kv. outdoor transformers and 15 kv. indoor switchgear.

Alluvial Gold Dredging in the Gold Coast Colony

AN interesting account is given in the *G.E.C. Journal* of February of the electrical equipment for the Bremang Gold Dredging Co., Ltd. This company dredges for alluvial gold on the Ankobra River, one of the larger rivers of the Gold Coast Colony, which flows roughly north and south and pours itself into the Gulf of Guinea. Many of the shallows of the river are sufficiently rich in alluvial gold deposits to warrant commercial development, and the Bremang Gold Dredging Co., Ltd., has installed equipment at two of these points for dredging mud and gravel from the river bed from which the gold is recovered. The dredges are electrically operated and are supplied from individual substations fed by a 55 kv. overhead transmission line from the power station of Ankobra Junction, a distance of about twenty miles.

The power station and the various camps from which the dredging operations are conducted are situated some 6° north of the equator in what was originally bush country with a humid tropical climate, but very great improvements in living conditions have been made in recent years. The bungalows provided for the accommodation of the European staff are of the most up-to-date type, with modern sanitary arrangements, electric light, fans, and running water supplied from specially constructed tanks. As regards diet, most of the vegetables are canned, but fresh potatoes are obtainable from Madeira, and green vegetables, such as lettuce and cabbage, can be grown locally provided the soil is adequately watered and sheltered from the sun. Cheese and butter are also available, and can now be kept in good condition almost indefinitely as a result of the installation of domestic refrigerators in the bungalows. Wireless programmes are provided by a local company at Prestea, and a relay station has been instituted in each camp with loud speakers in the individual bungalows. The native labour employed is recruited from local villages.

New Type of Rubber Paving Block

IN *Roads and Road Construction* of May 1 it is stated that Marylebone Borough Highways Committee reports that Universal Rubber Paviours, Ltd., of Manchester, have offered to provide and lay, free of cost to the Council, approximately 300 square yards of a new type of rubber paving block. The Council has already approved of the renewal of the concrete foundation and wood paving in Duke Street (Wigmore Street to Edward's Mews) which is considered to be a suitable site for the rubber paving. Other alternatives have been considered, but as the paving is to be subjected to skidding and other tests by the Ministry of Transport, it is necessary for the whole width of the carriageway to be paved with rubber and the section of Duke Street in question is of the desired width and length for the tests. The acting borough engineer reports that the new type of block appears to be an improvement on those laid by the same Company in Allsop Place, by Clarence Gate, some six years ago. By accepting the offer, the Council will save approximately £400 on the provision of wood blocks for the section of the carriageway in question.

National Radium Trust and Radium Commission

THE tenth annual reports of the National Radium Trust and Radium Commission (1938–1939) follow the general form of previous reports, but constitute, owing to special difficulties in planning for future developments, a more tenuous publication than usual. One of the most important events external to the chief work of the Commission has been the passing of the Cancer Act on March 29, 1939; this naturally receives a welcome from the Commission, and has been followed by an enlargement of the personnel of that body. As is generally known, the effect of the Act is to throw upon the major local authorities, county and county borough councils, the duty of securing proper facilities for cancer treatment on behalf of people in their areas; this will of necessity call for close collaboration with members of the Radium Commission whose knowledge and experience of radiological methods as practised in all the important centres in the country should secure a high level of efficiency in treatment and economy in practical methods.

Mortality in New York Hospitals

DURING 1938, the mortality-rate in the New York City hospitals for contagious diseases fell to 1·8 per cent, the lowest to date. This figure compares favourably with a 4–6 per cent mortality in general hospitals. There were 2,109 cases of whooping-cough admitted to hospitals in 1938, or more than for any year in the last two decades. Of all the cases of diphtheria notified to the Health Department in 1938, 43·7 per cent were admitted to hospital, while 31 per cent of the scarlet fever cases, 8 per cent of the measles cases and 16·1 per cent of the whooping-cough cases were sent to hospital.

Antiquities from the Eumorfopoulos Collections

ONE of the most interesting and important items in the sale of part of the Eumorfopoulos collections which took place at Messrs. Sotheby's rooms during May 28–31 was a third century B.C. toilet box. This was purchased by the National Arts Collection Fund for presentation to the British Museum (Bloomsbury). It is described as circular, with a diameter of 8¼ inches and a height of 5½ inches. It is decorated in greenish-red lacquer on a thin layer of fabric. The straight sides and domed top are ornamented with scrolls, birds and stylized animals, while on the sides of the cover are represented a horseman, a tiger and a charging bull on a chocolate brown ground enriched with silver inlay. With the box was a bronze mirror of the Warring States period (*c.* 481–221 B.C.) which had been found inside it. Among other antiquities of special interest was an example of the remarkable and rare bronze-covered wine vessels of the little-known Shang Dynasty (? 1766–? 1122 B.C.), this specimen having a silvery-green and red-brown patina, a Kmer female torso in grey limestone of the eleventh century of our era, a period of perhaps the greatest efflorescence of the Kmer art of south-eastern Asia, and the magnificent gold furnishings of a fifteenth century Ming emperor's tomb.

Recent Earthquakes

DURING May 18–19, fifty people were killed and many injured at Mexicali near the border of the United States, where houses and Government buildings were damaged. Fifteen earthquakes were felt. In Africa strong shocks were felt on the night of May 19 on the Zululand coast, in Natal, in the Transvaal and in the Limpopo area. The epicentre may have been off the Zululand coast. Local tremors were felt in the Rand. About 23.55 G.M.T. on May 18 local tremors were felt at Deganwy, North Wales, by Mr. Willoughby Gardner, who reported the matter to *The Times*. These may have been due to movement along the Conway fault system.

Over the same week-end strong shocks were recorded on Mr. J. J. Shaw's seismographs at West Bromwich, and Father Rowland states that the seismograph at Stonyhurst College Observatory recorded a strong shock lasting about three hours, commencing on May 19 about 4.40 G.M.T. At Kew the seismographs commenced recording on May 19 at 4h. 48m. 53s. G.M.T. and finished at 7h. 45m., with a maximum ground amplitude at Kew of 0·029 mm. A second shock was registered at Kew at 15h. 29m. approximately on the same day, though this was only small.

Announcements

IT is announced that the British Association has reluctantly decided to cancel the Conference on Science in National and International Aspects which was to have been held at Reading during July 25–27.

MR. T. L. ASQUITH, chemist, Royal Ordnance Factory, has been appointed an additional member of the Civil Division of the Order of the British Empire, for services in connexion with an explosion at the Royal Ordnance Factory on April 2.

THE following officers for 1940–41 of the Royal Aeronautical Society have recently been elected: *President*, Dr. A. H. R. Fedden; *Vice-Presidents*, Mr. Griffith Brewer and Air Vice-Marshal R. M. Hill; *Honorary Treasurer*, Major D. H. Kennedy; *Honorary Librarian*, Mr. J. E. Hodgson; *Secretary and Editor*, Captain J. Laurence Pritchard.

MR. DONALD C. BRADFORD has been appointed seismologist at the University of Pittsburgh. The seismological station is in the basement of the "Cathedral of Learning", a skyscraper close to the main traffic arteries of the city. It has been found that the two Wenner horizontal seismometers and the Benioff vertical seismograph function quite satisfactorily, contrary to expectations before 1931 when the site was tested and recording began.

THE sixth University in the Argentine Republic has recently been founded at Mendoza.

MORE than 9,000 natives died from malaria in the Transvaal during the year ended March 31, 1939. According to the Department of Public Health the heavy rains at the end of 1938 and the beginning of 1939 made conditions favourable for malarial mosquitoes. The chief difference between this epidemic and that of 1937 was not one of severity but of extent, the 1939 epidemic reaching over a greater area and going so far south as Pretoria.

LETTERS TO THE EDITORS.

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 901.

Excited States of Stable Nuclei

WE have recently carried out some experiments on the scattering of protons by light elements, using the proton beam provided by the Liverpool cyclotron and detecting the scattered particles by the photographic method.

A proton beam of about 10^{-8} amperes, with a divergence of one degree, is defined by a system of stops, and emerges from an attachment to the vacuum tank of the cyclotron into the 'camera' through a mica window covering a hole $\frac{1}{8}$ in. in diameter. In the camera this narrow proton beam passes down the axis of a tube, which is interrupted for a length of 3 mm. to allow the scattered particles to emerge. A flat photographic plate is placed so that its surface is parallel to the axis of the beam and at a distance of 1 cm. from it. The protons scattered by the gas with which the camera is filled emerge through the interruption and enter the plate at a small glancing angle. This arrangement has the advantage that a single plate can contain the information for determining the probability of scattering from about 15° to 150°, providing for each angle regions containing a suitable number of tracks for counting purposes. At the same time, the energy of the scattered particle can be determined from the length of its track in the photographic emulsion.

Once the difficulties of defining the beam in the stray field of the magnet had been overcome, we found that suitable exposures could be obtained for some six to eight different scattering gases per day.

We have taken plates of the scattering from eleven elements which could be obtained either as elementary gases or in the form of suitable gaseous compounds. The energy of the incident particles at the point of scattering was about 4 million volts. The plates for hydrogen, deuterium and helium are satisfactory, and work is proceeding on these; but we wish to direct attention here to the inelastic scattering which accompanies the elastic scattering from the heavier elements, and gives information about the excited states of the stable nuclei in a particularly direct way.

The distributions in energy of the protons scattered through 90° from the gases oxygen and neon are shown in Fig. 1. In oxygen a single peak appears, corresponding in energy to protons elastically scattered through 90°. With neon, in addition to the elastically scattered group, there is a peak at lower energy which we attribute to inelastic scattering from ^{20}Ne. This view is supported by the fact, deduced from the analysis of the neutron spectrum of fluorine under deuteron bombardment, that ^{20}Ne has an excited state of 1·4 Mev., for the difference in energy of the two groups of scattered particles is just of this amount.

We have examined the variation of the probability of scattering with angle for elastic and inelastic scattering in neon, and the results are shown in Fig. 2. It will be seen that in the range from 40° to 80° the elastic scattering follows very closely that expected from pure Coulomb scattering. In contrast with this, the inelastically scattered particles are distributed spherically symmetrically about the centre of mass of the system, to within the present accuracy of the measurements. This suggests that the inelastically scattered protons have been 'evaporated'

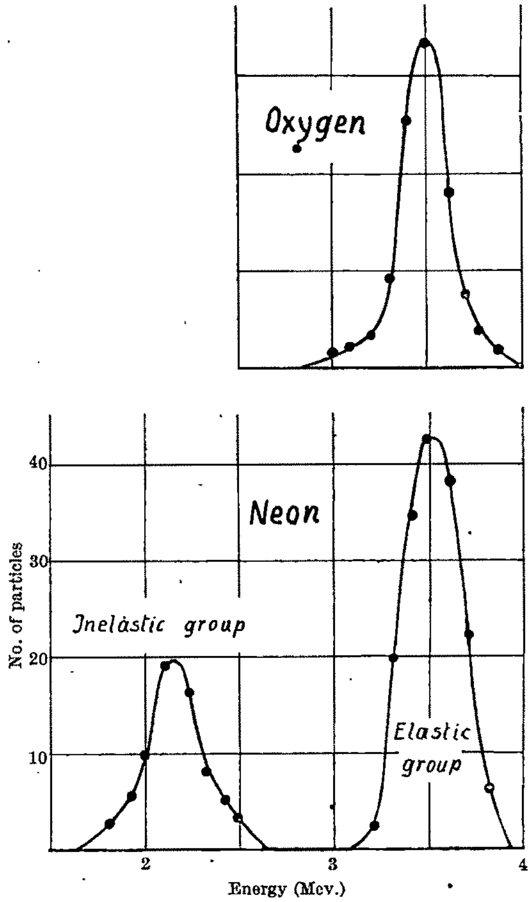


Fig. 1.

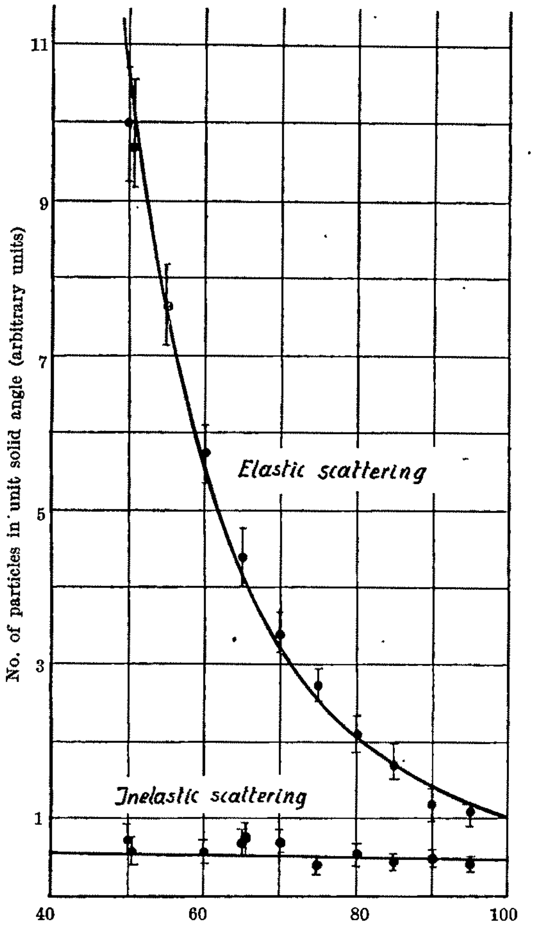


Fig. 2.

from the compound nucleus formed in a close collision of an incident proton and a ^{20}Ne nucleus.

The absence of inelastically scattered protons in oxygen in the conditions of our experiments is evidently due to the fact that there is no excited state of oxygen below 4 Mev. The variation of scattering with angle shows, however, strong anomalies from Rutherford scattering at angles greater than about 45°, the number of scattered particles per unit solid angle varying only slowly with angle. This point will be investigated further.

With the elements of atomic number greater than that of neon which we have examined, such as chlorine and argon, the ratio of the number of inelastically to elastically scattered particles is very much smaller than in the case of neon, corresponding to the decreasing probability of the protons entering the nucleus with increasing nuclear charge. It is therefore evident that it will be desirable to continue the experiments with protons of higher energy in order that the higher excited states of the light elements may become accessible to investigation, and to obtain results for elements of higher atomic number. It is clear from our experience, however, that the method is very powerful, the plates being obtained with an exposure of a few minutes and the analysis of the energy distribution of the scattered protons being complete within a few hours. Also the use of what are essentially gas targets gives the advantage of purity control and absence of effects associated with energy loss in the target. We may expect these advantages in experiments of a similar character with high-energy deuterons, where the scattered primary particles may be accompanied by disintegration products.

In general, we may conclude that, using the photographic method of detection, it becomes possible to take advantage of the high-energy particles provided by the cyclotron to make experiments of the kind which have hitherto only been undertaken with direct current generators at relatively low energies.

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Photographic Plates as Detectors of Mesotron Showers

During the last two years we have been using photographic plates (Ilford R_2 and New Halftone) for the study of cosmic rays at different altitudes. Both treated and untreated plates have been used for the purpose. In the present communication is reported the results obtained by keeping for five months untreated New Halftone plates in cardboard containers, vertically on their long sides, at Darjeeling (Mayapuri Research Station, elevation 2,130 m.) and at Sandakphu (Dak Bungalow, elevation 3,660 m.).

In the plate kept at Sandakphu, on an area of 0·5 cm.^{2} were observed 40 long single tracks, 15 double, 8 three-star, 12 four-star, 3 five-star, and one each of six- and seven-star tracks. Blau and Wambacher[1], whose technique we have followed, kept similar untreated plates at Hafelekar (2,300 m.) for five months. They obtained a large number of long single tracks and also a number of stars, but apparently no double tracks. On the assumption that the tracks are due to protons, they have calculated their kinetic energies. For this purpose they have used a calibration curve expressing the kinetic energies of the ionizing particles as a function of the mean grain distance along their tracks. The maximum energy for a star was found to be 103 × 10^6 ev., with a mean energy of 16 × 10^6 ev. per track.

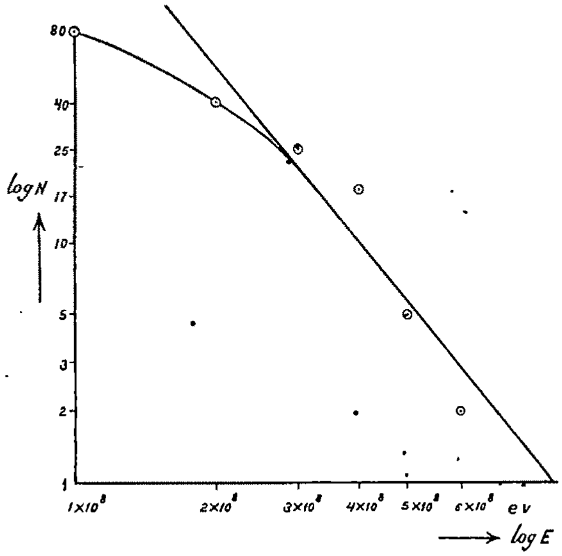
In the absence of such a calibration curve, we have calculated the energies of the particles in our plate from their measured track lengths on the emulsion. We also made the tentative assumption that the tracks are due to protons, and their kinetic energies were found to be of the order of 10^6 ev. This represents a minimum estimate of their kinetic energies. In view of the recent discussions on the nature of the small-angle penetrating showers, attributed to mesotrons by Bothe and Schmeiser[2], our attention was first directed to the pair tracks found in the plate kept at Sandakphu. Of the fifteen pair tracks, thirteen had angles between 6° and 21°, and one had an angle of 24° and the other 35°. Their kinetic energies varied from 2 to 4 Mev. It appeared plausible to make the assumption that these tracks were due to mesotron pairs, and to apply to them the formula given by Wentzel[3], limiting the angular spread θ of such showers, where $\theta \lesssim \frac{\bar{\lambda}}{a} \lesssim \frac{\hbar c}{\varepsilon a}$, in our case $\varepsilon = z(x + \bar{\varepsilon})$ where x is mass energy of a mesotron $\sim 10^8$ ev., $\bar{\varepsilon}$ is average kinetic energy of mesotrons in these pairs, $\sim 2 \cdot 9 \times 10^6$ ev.; and $\bar{\theta}$ is mean angle of scattering, $\sim 8°$.

In view of the relative order of magnitudes of x and $\bar{\varepsilon}$, not much error is introduced in calculating $\bar{\varepsilon}$ on the assumption that the tracks are due to protons and not mesotrons. For low velocities, the densities of ionization along the tracks of protons and mesotrons, for equal range in air, are of the order of 1·3 to 1.

We have calculated the value of a, the linear dimension of the scattering centres inside a nucleus on which mesotron packets, created by the impact of high-energy cosmic-ray particles on nuclear protons or neutrons, are scattered. The value of a is found to be $6 \cdot 7 \times 10^{-13}$ cm., which is comparable with the electron radius $2 \cdot 8 \times 10^{-13}$ cm.; it is of the right order of magnitude.

Next we proceed to the consideration of the origin of the star-like tracks. All of them contain tracks of the same nature, but in a few can be seen in addition one or two tracks due to heavier charged particles. For calculation we have assumed them all to be due to mesotrons. It is not clear whether the reasoning used by Wentzel can be applied to a multiple track shower. We have therefore made use of the hypothesis of multiple particle emission introduced by Heisenberg[4], according to which during the impact of a high-energy cosmic-ray particle with a nuclear proton or neutron, a part of the virtual mesotron field of the latter is radiated away as a mesotron wave packet. The latter is confined initially to a very small volume, but due to interference between parts of the wave packet, a number of secondary mesotrons are produced. If ε is the energy made available during the impact, then on an average $\bar{n}$ mesotrons will be produced where $\bar{n} = \varepsilon/n \log \varepsilon/x$, and the mean energy of a mesotron is $x \log \varepsilon/x$, which is nearly a constant. To a first approximation our results appear to be in agreement with the above. Each star on our plate represents an energy transformation, $\varepsilon = n(x + \varepsilon^*)$, where $n = 1, 2, \ldots 7$, and $\varepsilon^* \sim 10^6$ ev.

In the accompanying graph, we have plotted the curve $N = A\varepsilon^{\gamma}$, where N represents the number of stars with energies greater than ε. The value of γ, the tangent to the straight portion of the curve, comes out to be 2·5, which is of the accepted order, as others have found it to vary from 1·8 to 2·5.



It therefore appears probable that the tracks found in the Ilford Halftone plates are mostly due to secondary mesotrons. We have computed the total energies of these mesotron tracks per unit area of the plates kept at Sandakphu and at Darjeeling; their ratio is found to be 2·3, which is near the value of 2·0 obtained for the ratio of the ionization at these two altitudes from the curve given in Swann and Danforth's paper[5].

The soft component of the cosmic radiation may be considered to be responsible for their origin. The pair-tracks give no indication of being due to any fast primary ionizing particles, and are probably of photonic origin. Their kinetic energies are of the order of $10^6 - 10^7$ ev., and they are of the same nature as the slow mesotrons postulated as accompanying fast mesotrons by Maier Leibnitz[6]. That a portion of these slow mesotrons can be of photonic origin is admitted by the latter. Further evidence about the existence of these slow mesotrons will be found in Bothe's paper. A detailed account will be published in the *Transactions of the Bose Institute*.

D. M. BOSE.
BIVA CHOWDHRY.

Bose Research Institute,
Calcutta.
April 6.

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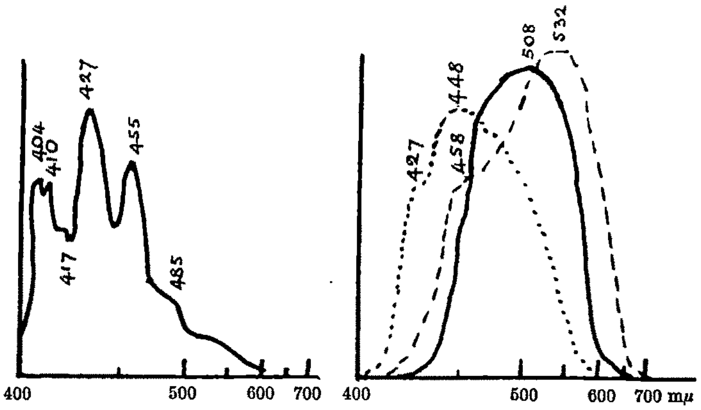
[1] Blau and Wambacher, *Wien Akad.*, Abt. II A, **146**, 469, 623 (1937).
[2] Bothe, *Rev. Mod. Phys.*, **11**, 282 (1939).
[3] Wentzel, *Phys. Rev.*, **54**, 869 (1938).
[4] Heisenberg, *Z. Phys.*, **113**, 61 (1939).
[5] Swann and Danforth, *J. Franklin Inst.*, 48 (1939).
[6] Maier Leibnitz, *Z. Phys.*, **112**, 569 (1939).

Some Physico-Chemical Properties of 3 : 4,Benzpyrene

IN contrast with the characteristic fluorescence spectrum (Curve 1) which 3 : 4,benzpyrene always emits when it is dissolved in solvents, we have observed three different types of fluorescent spectra (Curves 2, 3, 4) when the hydrocarbon was excited in the solid state. The needles of a commercial benzpyrene (La Roche) emit a green fluorescent light and we call it therefore the 'green' form. Curve 2 exhibits a broad rather symmetrical band with its flat maximum between 500 and 510 mμ. On pouring an acetone solution of the green form of benzpyrene into cold water there results the well-known colloidal suspension of benzpyrene which emits a yellowish fluorescence. The spectrogram of this 'yellow' form has its maximum between 530 mμ and 540 mμ, and a typical inflection at the short wave-length side of the band (Curve 3). On heating the green form in an evacuated tube, a white sublimate is formed on the tube walls which fluoresces brightly blue. The spectrogram of this 'blue' form shows a maximum between 445 mμ and 450 mμ, and an inflection on the short-wave-length side which appears as a contrast band at about 425 mμ (Curve 4). The sublimed crystals are small plates with typically curved edges. We believe that they are identical with the modification of benzpyrene which Iball[2] obtained from a solution in amyl acetate. According to his X-ray analysis, they are orthorhombic, while the needles (our green form) belong to the monoclinic system. Iball did not examine the fluorescence of either form.



Curve 1.

Curve 2, full line; curve 3, broken line; curve 4, dotted line.

PHOTOMETRIC CURVES OF THE SPECTROGRAMS ON PANCHROMATIC PLATES OF THE FLUORESCENCE OF 3 : 4,BENZPYRENE (1) DISSOLVED IN ACETONE AND (2–4) IN VARIOUS SOLID FORMS. THE GRAPHS WERE RECORDED WITH GOLDBERG'S[1] (1910) DENSOGRAPH, WHICH SERVED AS A PRIMITIVE MICROPHOTOMETER.

The three modifications of benzpyrene undergo several spontaneous transformations. (1) The green form is transformed into the blue form at high temperatures. The lowest temperature at which we observed the disintegration of the clear original needles was 67°. (2) The blue form is changed into the green form at low and moderate temperatures. This change of the plates into the needles can be easily seen under the microscope if one moistens the crystals of the blue form with a drop of any solvent. We observed it still at 65°. (3) The yellow form goes over into the blue form on keeping the colloidal suspension for a few hours at 100°. It is also quickly transformed into the green form at ordinary temperature by moistening the dry residue from the evaporated colloidal suspension with a drop of amyl acetate.

It follows from (1) and (2) that the green and blue forms are enantiomorphous modifications of benzpyrene with a triple point at about 66°. According to the thermodynamics of heterogeneous systems, the work done during the spontaneous transformation of one mole is :

$$W = RT \ln \frac{p_{\text{bl}}}{p_{\text{gr}}} = RT \ln \frac{s_{\text{bl}}}{s_{\text{gr}}},$$

where p_{bl}, p_{gr}, s_{bl}, s_{gr} are the vapour pressures and solubilities of the blue form and the green form, respectively. Because below 66° the green form is more stable than the blue form, the solubility of the blue form is greater than that of the green form, and *vice versa* above 66°. This is true for any solvent, and in particular we know now which form has at a given temperature the higher solubility in water, though the solubility of neither form has been directly determined.

From the transformation (3) it follows that the yellow form has the highest solubility of the three forms at all temperatures. This is consistent with the assumption that the yellow form is a microcrystalline form of the green form. The order of the solubilities below 66° is $s_y > s_{\text{bl}} > s_{\text{gr}}$, and above 66° $s_y > s_{\text{gr}} > s_{\text{bl}}$. In the same order the modifications may undergo spontaneous transformations with release of free energy.

We have also examined mixtures of colloidal suspensions of benzpyrene with cholesterol. With large amounts of benzpyrene the spectrum was the same as that of the yellow form (Curve 3). With decreasing amounts the composition of the mixed spectrum shifted from Curve 3 to Curve 4 and then to 1. The fluorescence colour of these mixtures was liable to a typical change which happened very slowly at room temperature but more quickly at elevated temperatures. The spectrum approaches more and more that of the blue form.

Because we know that the blue form represents below 66° an intermediate stage between the quite unstable yellow and the stable green form of benzpyrene, it follows from the experiments that this intermediate blue stage can be stabilized by the presence of cholesterol. The stabilization cannot be but temporary owing to the tendency of the blue form towards spontaneous transformation into the green form with release of free energy.

It is possible that these facts account for the biological activity of benzpyrene. It may be that, as with cholesterol, the lipoids of the cell coming into contact with benzpyrene stabilize its unstable form temporarily. The spontaneous transformation into the stable form may release energy for biological action. Experiments from this point of view are in progress with various carcinogenic compounds.

The research was supported by a grant from the British Empire Cancer Campaign for which we are very grateful. We are indebted to Prof. C. K. Ingold and Dr. C. F. Goodeve for the loan of a spectrograph.

F. WEIGERT.
J. C. MOTTRAM.

Mount Vernon Hospital,
Northwood, Middlesex.
April 20.

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[1] Goldberg, E., *Z. Reprod. Techn.*, No. 4 (1910).

[2] Iball, J., *Z. Kryst.*, A, 94, 7 (1936).

Latent Energy and Dissociation in Flame Gases

THE gases remaining after flame has spread through an inflammable mixture are not just hot normal gases. The view has been put forward[1] that they contain a considerable latent energy in stable form. This probably resides in a proportion of the newly formed triatomic molecules as excess intra-molecular energy which cannot be handed over to the translational degrees of freedom. In virtue of the excess intra-molecular energy, it would appear that there is a much larger dissociation in flame gases than in normal gases of the same composition under similar conditions of temperature and pressure.

Two series of experiments which we have recently completed seem to us to lend strong support to these views. They relate to temperature determinations in flame gases carried out by means of change of resistance measurements of thin platinum-rhodium wires (0·0005 in. diameter) and of quartz-covered platinum wires (overall diameter 0·0005 in.) immersed in the gases.

The first series of experiments was made during the pre-pressure period in large closed-vessel explosions of mixtures of carbon monoxide and air of various mixture strengths. During this period, as is well known, a considerable volume of inflammation takes place at sensibly constant pressure. The results of these experiments are summarized in the curves in Fig. 1. It will be noticed that for very over-rich mixtures (50 per cent carbon monoxide and more) the two wires show the same temperatures, but for weaker mixtures the plain wire temperatures are much greater than the quartz-coated wire temperatures—nearly 400° C. greater for the combining proportions mixture. The shape of the quartz-covered wire temperature curve suggests abnormally large dissociation of the carbon dioxide in the products of combustion, which tends to be more and more suppressed as the concentration of carbon monoxide is increased. The high temperatures of the plain wires appear to result from the combination on their surface of the abnormally dissociated carbon dioxide.

In the second series, the temperature distribution was determined by means of the two types of wire along the radius of a sphere of 18 in. diameter *after* the completion of the explosion of a centrally ignited inflammable mixture consisting of 10 per cent carbon monoxide plus 7 per cent hydrogen and air. The curves in Fig. 2 summarize these measurements. It will be seen that the temperature gradient from the centre outwards as shown by the quartz-covered wire is not very large, but the point to which we wish to direct special attention is that whereas the difference between the plain and the quartz-covered wire temperatures is relatively small towards the end of the radius, it is very large (amounting to some 300° C.) near the centre. In order to explain these results it appears to be necessary to assume that the abnormal dissociation is greatest in the gases first ignited and decreases in those ignited later. Experimental results previously reported suggest that the latent energy in the flame gases left behind the flame front decreases with distance of flame travel from the igniting sources[1,2], and, assuming that the amount of abnormal dissociation varies with the latent energy, the results now reported would appear to be in line.

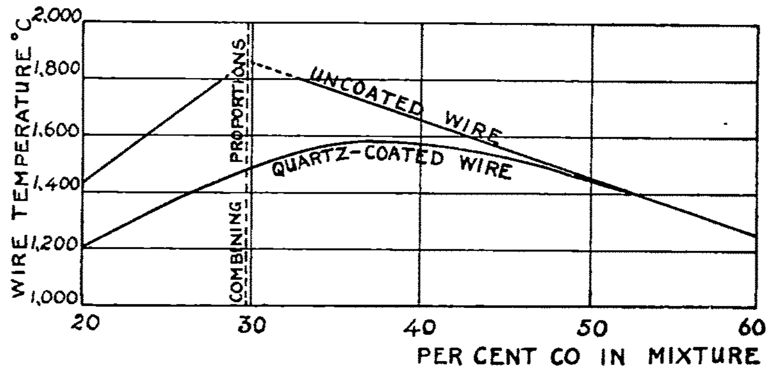

Fig. 1.

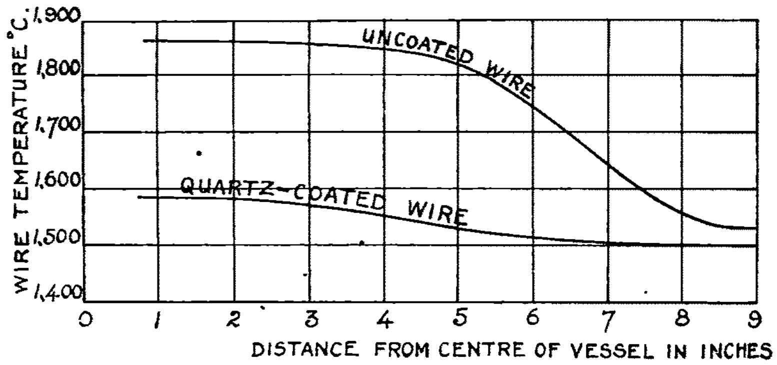

Fig. 2.

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B. Pugh.

Engineering Department,
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[1] David, *Phil. Mag.*, 23, 345 (1937).

[2] David, *Engineering*, 531 (Nov. 12, 1937).

Latent Energy and Dissociation in Explosions

The suggestion has been put forward by Prof. David and Mr. Pugh[1] from the results of flame temperature experiments that the large latent energies found in flame gases, due probably to excess intramolecular energy in the triatomic molecules formed during combustion, facilitate the dissociation of the products, with the result that excessive dissociation is observed. The results of a number of closed-vessel explosion experiments confirm this view, and also indicate that the degree of such dissociation is, as would be expected, dependent on the amount of latent energy associated with the products of combustion.

It has been shown by David, Brown and El Din[2], and David and Leah[3] that the latent energy in explosions is dependent on the size of the explosion vessel used and also upon the initial density of the inflammable mixture. Series of explosions of carbon monoxide and air mixtures recently carried out in redesigned apparatus at initial pressures of ½, 1 and 3 atmospheres in two spherical vessels of 6 in. and 17·45 in. internal diameter may be used to determine the equilibrium constant for the reaction

$$2\,CO + O_2 \rightleftarrows 2CO_2$$

by the method of Fenning and Tizard[4]. The average latent energy varies with the initial conditions and an interesting correlation can be made.

The results are shown in the table below. The initial pressures are given in the first column, the maximum temperature attained in the second column and $\log_{10} \dfrac{Kp\text{ obs.}}{Kp\text{ theor.}}$, *Kp* obs. being the calculated equilibrium constant and *Kp* theor. the theoretical quantum value, in the third column. In the last column the average latent energy found is given. Comparison of the figures given in the last two columns shows the

Pi Atmos.	*Tm*° K.	$\log_{10} \frac{Kp \text{ obs.}}{Kp \text{ theor.}}$	L. E. % heat of combustion
	Large Explosion Vessel		
½	2590	0·47	5·0
1	2650	0·40	3·5
3	2750	0·32	2·5
	Small Explosion Vessel		
½	2510	0·81	7·0
1	2585	0·67	6·0
3	2645	0·73	5·5

remarkable proportionality between $\log_{10} \frac{Kp \text{ obs.}}{Kp \text{ theor.}}$ and the latent energy, indicating the dependence of abnormal dissociation upon latent energy.

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[1] See preceeding letter.
[2] *Phil. Mag.*, (7), **14**, 764 (1932).
[3] *Phil. Mag.*, (7), **22**, 513 (1936).
Proc. Roy. Soc., A, **115**, 318 (1927).

Diffusion in Palladium

THERE has been considerable discussion[1,2,3] as to why the rate of diffusion of hydrogen through metals, instead of reaching a limiting constant value, continues to obey a $\sqrt{p}$-law even when the pressure p is several hundred atmospheres. Recently the view was advanced[3] that although the pressure outside the metal may be high, owing to a slow rate of transport through the boundary

adsorbed layer → metal

as compared with a rapid diffusion within the metal, there is always only a small concentration just inside the metal, which is built up according to the $\sqrt{p}$-law. If, however, it can be built up sufficiently, the concentration just inside the metal will approach the saturation value, and the $\sqrt{p}$-law can then no longer hold. This condition has previously never been realized.

Two circumstances would contribute to the breakdown of the $\sqrt{p}$-law : (*a*) a very high rate of supply of atoms to the metal surface ; (*b*) a high rate of transport across the surface.

To achieve (*a*) caustic soda solutions were electrolysed (at considerable current density) with a palladium tube as cathode. (*b*) requires a freshly oxidized and reduced palladium surface[4]. Of several tubes, only one gave the desired surface activity, which decreased successively between experiments, and gave the following results : (i) in its most active state the palladium showed a permeation rate for hydrogen *independent of current density* ; (ii) in its next most active state the curve between permeation-rate and $\sqrt{I}$ (I is current density) was parabolic (convex to the $\sqrt{I}$ axis) ; (iii) with successive stages of deactivation the curve approached a linear form.

These and other results on diffusion in metals will shortly be discussed more fully. The present results afford very satisfactory evidence of changes in the relative velocities of phase boundary reactions and of diffusion with time, and of the theory of diffusion discussed earlier[3].

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Chemical Laboratories,
Technical College,
Bradford.
April 23.

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[1] Smithells, C., "Gases and Metals" (Chapman and Hall, 1937), p. 105.
[2] Wang, J., *Proc. Camb. Phil. Soc.*, **32**, 652 (1936).
[3] Barrer, R., *Phil. Mag.*, **28**, 353 (1939).
[4] Lombard, Eichner and Albert, *Bull. Soc. Chim.*, **3**, 2203 (1936).

Solar and Terrestrial Relationships of March 23-29, 1940

IT is of interest to compare Father Rowland's account[1] of the great magnetic storms in the last week of March with the record of disturbances in the solar chromosphere during the same period.

The first bright chromospheric eruption of great intensity was observed with the Greenwich spectrohelioscope in $H\alpha$ light on March 23 at 11h. 30m.[2] The area covered by this eruption included the group of sunspots which was at the time three days before central meridian passage. A simultaneous wireless fade-out on wave-lengths below 50 metres was reported by the Cable and Wireless Co., starting at 11h. 8m. and lasting for 1¼ hours. It is significant that this fade-out only occurred in the channels of communication on the sunlit side of the earth. Communications through the opposite hemisphere were normal. The first of the magnetic storms followed approximately 26 hours later, beginning on March 24 at 13h. 45m., and a brilliant aurora was observed from the north of England the same evening.

The second period of activity began on March 27, when a bright eruption covering the same sunspot group was observed here at 17h. 10m. This was the brightest eruption of its kind so far observed with the Sherborne spectrohelioscope, and, like that of March 23, it was accompanied by a wireless fade-out lasting from 16h. 19m. to 18h. 30m. The magnetic storm of March 29, 16h., began just 48 hours later, and an aurora was again observed from British stations on the same evening.

This record of magnetic and solar activity, though possibly not yet complete, tends to confirm the evidence, recently summarized by H. W. Newton[3], suggesting a critical relationship between major chromospheric eruptions and 'great' magnetic storms, with an average time lag of 1½ days between the two phenomena. In neither of the above cases was it possible to observe the beginning of the eruption, so that the synchronism with the sudden beginning of the wireless fade-out could not be verified. In previous coincidences there has been an average interval of a few minutes between the beginning of the eruption and the onset of the fade-out, from which we may possibly conclude that the growing eruption must reach a certain limit of intensity or area, or of both combined, before the increase in ultra-violet radiation is sufficient to affect the ionosphere.

M. A. ELLISON.

Sherborne,
Dorset. April 26.

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[1] NATURE, **145**, 625 (1940).
[2] *J. Brit. Astro. Assoc.*, 202 (April 1940).
[3] *The Observatory*, **62**, No. 787

Intestinal Sugar Absorption and Phosphate Metabolism

IT has been shown in previous work that the selective absorption of sugars from the intestine of rats is strongly affected by iodoacetate[1]: after administration of this poison all hexoses are absorbed at the same rate. This has been interpreted as due to the fact that phosphorylation of sugars accelerates their absorption. It was shown that extracts of intestinal mucosa phosphorylize those sugars which are selectively absorbed; furthermore, that iodoacetate inhibits this phosphorylation[2] and that organic phosphate in the intestinal mucosa increases during sugar absorption[3].

It has now been found that absorption of any monosaccharide from isolated loops of the small intestine causes inorganic phosphate to enter the intestine, whereas absorption of sodium chloride or amino-acids has no such effect. Sugars which are not selectively absorbed also increase intestinal phosphates, but the change of concentration with time is different; with glucose the intestinal phosphate content is maximal already after 15 minutes and then falls off to about zero in about 1½ hours, whereas with xylose it rises slowly to about the same level in 45 minutes. After iodoacetate administration this difference disappears, and the phosphate content of the intestine after 45 minutes is the same for xylose and glucose. Also after adrenalectomy the reabsorption of phosphate during glucose absorption is suppressed. Thus entry and reabsorption of phosphate seems related to the selective absorption of sugars.

Experiments on the role of various endocrine glands which control intestinal sugar absorption are at present being carried out. It is also hoped that future work along the same line may throw light on the problem of phosphate metabolism in the bones. The results will be published in detail later.

L. LASZT.

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University of Fribourg,
Switzerland.
April 30.

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[1] Wilbrand, W., and Laszt, L., *Biochem. Z.*, **259**, 398 (1933).

[2] Laszt, L., *Biochem. Z.*, **276**, 44 (1935).

[3] Laszt, L., and Süllmann, H., *Biochem. Z.*, **278**, 401 (1935).

Effect of Inversion of a Small Piece from the Fruit-Body of *Ganoderma lucidus* (Leyss.) Karst. growing *in situ* on the Trunk of *Casuarina equisetifolia*

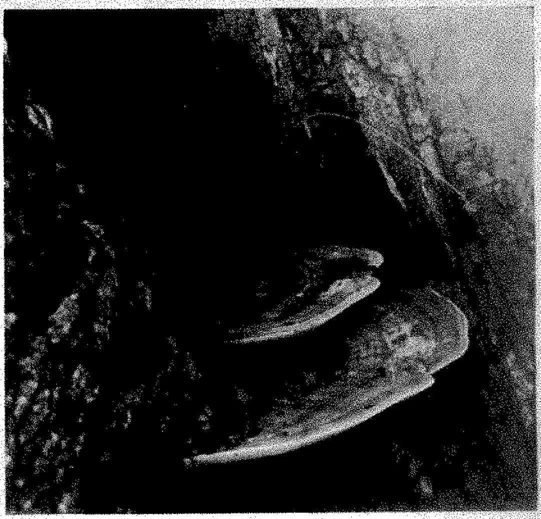

Fig. 1.

TWO SPOROPHORES OF *Ganoderma lucidus*, ONE GROWING ABOVE THE OTHER ON THE TRUNK OF *Casuarina equisetifolia*.

BRACKET-SHAPED sporophores of *Ganoderma lucidus* were growing on the trunk of an old tree of *Casuarina equisetifolia* in the Royal Botanical Gardens, Sibpur (Calcutta) in front of the superintendent's quarters on the bank of the Ganges. From each of the two sporophores, one growing over the other (Fig. 1), a narrow sector was cut out almost in the middle and inserted (on September 6, 1939) in the inverted position, that is, with the porous surface upwards in the cavity thus produced. It was found that in the course of nine days regeneration of the hyphæ began by way of stitching from two sides (Fig. 1). A number of interwoven hyphæ developed between the old sporophore and the new piece. The hymenial surface of the specimens was perfectly white in

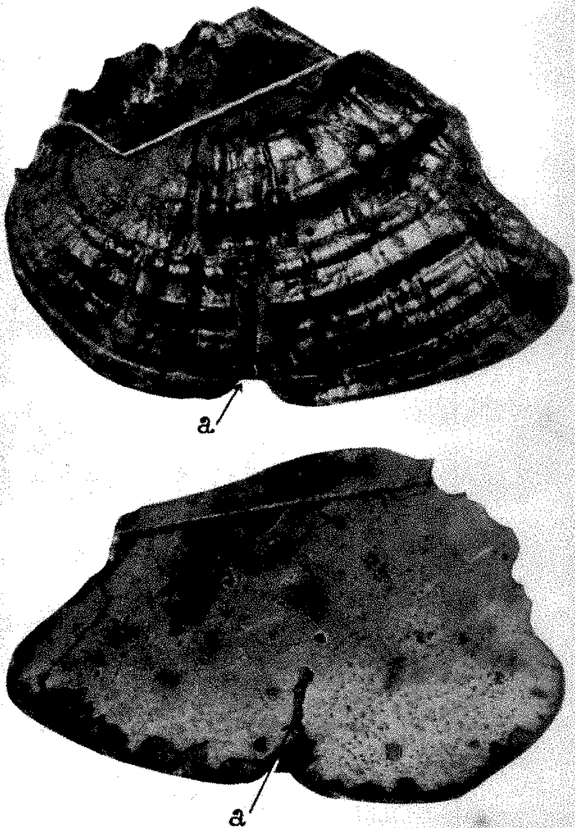

Fig. 2.

ABOVE—UPPER SURFACE OF THE SPOROPHORE OF *Ganoderma lucidus* SHOWING THE DEVELOPMENT OF LACCATE CRUST ON THE UPPER FACE OF THE CUT-OUT SECTOR AT *a*.

BELOW—HYMENIAL SURFACE OF THE SAME SHOWING FLANKING-OVER HYMENIAL GROWTH FROM TWO SIDES ON THE CRUST OF THE CUT-OUT SECTOR AT *a*.

September; copious spore-discharge continued for about two months, the adjoining areas of the trunk becoming dusted over with Ganoderma spores. Gradually, the lower surface turned pinkish and finally brownish with stoppage of spore-discharge by the following December. In the course of these three months the porous area on the upper face of the cut-out sector became gradually covered with the typical laccate crust-growth of the upper surface (Fig. 2, above) and its lower surface was at the same time flanked over with hymenial growth from two sides (Fig. 2, below). A section of the present upper face of the sector showed the typical thick-walled palisade hyphæ in close cluster with a number of brown shot-out spores here and there under the new crust (Fig. 3).

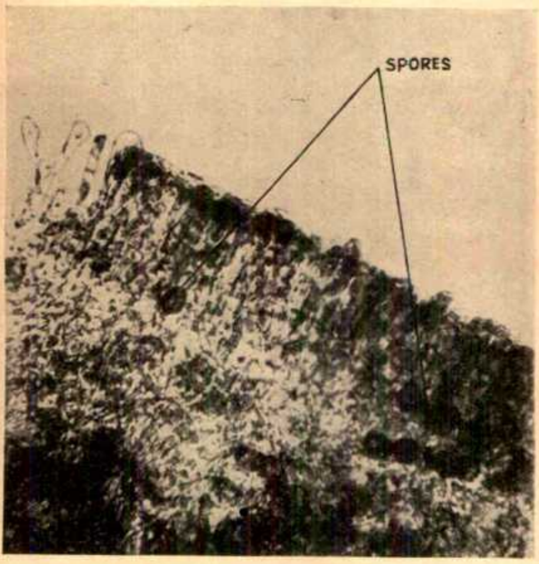

Fig. 3.

PHOTOMICROGRAPH OF A SECTION OF THE NEWLY DEVELOPED CRUST SHOWING THICK-WALLED PALISADE-LIKE HYPHÆ AND A NUMBER OF BROWN SPORES AT A LOWER LEVEL.

(Leitz objective No. 7. Eyepiece No. 75.)

This experiment lends support to the view recently put forward by Němec[1] and Lohwag[2] that the polarity in cases of some Polypores is convertible.

In another sporophore a narrow triangular gap was caused by removing a thin slice from about the middle; it was found that the gap was gradually bridged over in the course of about two months by numerous young hyphæ growing from two sides all over, except the outer thick crust.

For the photographs of Figs. 1 and 2 I am grateful to Dr. K. P. Biswas, superintendent of the Royal Botanical Gardens, Calcutta, and to Dr. D. B. Chatterjee.

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Botanical Laboratory,
Carmichael Medical College,
Calcutta.
March 1.

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[1] Němec, B., *Bull. Internat. Acad. Tscheque, C. Math. Nat. et. Med.*, **36** (1935).

[2] Lohwag, K., *Ann. Mycol.*, **37**, 169 (1939).

Gynospore Formation in *Sequoia sempervirens*

IN spite of the intrinsic interest of the redwoods and mammoth trees of California their gametophytes and embryogeny were poorly known until recently. Lawson's[1] account of *Sequoia sempervirens* was unsatisfactory and incomplete and only a cursory reference by Arnoldi[2] was available for *S. gigantea*. Looby and I[3], however, described recently fertilization and proembryo formation in *S. gigantea* for the first time and also extended and amended Lawson's[1] account of these features in the redwood; while Buchholz[4] afterwards dealt with the embryogeny in both types. It is clear from the results recorded that development in these two trees is so different that they can no longer be retained in the one genus.

Except for the doubtful account by Lawson[1] of gynospore formation in *S. sempervirens*, no accurate description has yet been given of the early origin and development of the gynospores in either case. Collections have now been made to cover these phases and so complete the full life-history; and these phases also are quite different in the two plants. Details will be published in due course, but it seemed advisable to put on immediate record the unique condition found in *S. sempervirens*. A number of gynospore mother cells are commonly formed, of which up to eight (or more ?) may form tetrads. The members of a spore tetrad may form a linear row, but more frequently the gynospores are in compact groups of four, arranged symmetrically in one plane or in a tetrahedron, the whole being surrounded by a definite tapetum, usually of one cell layer. A transverse section of the ovule at this stage resembles a young pollen sac in a remarkable way.

In no other conifer is the sporangial nature of the nucellus so clearly shown. As these tetrads are only a little larger than the pollen tetrads this condition in the redwood is a further cogent argument against the continued use of the terms mega- and micro-spore for the spores of the conifers, with all that the use of these terms commonly implies.

J. DOYLE.

Botany Department,
University College,
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May 3.

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[1] Lawson, *Ann. Bot.*, **18**, 1 (1904).

[2] Arnoldi, *Bull. Soc. Nat. Moscow*, **14**, 449 (1900).

[3] Looby and Doyle, *Sci. Proc. Roy. Dub. Soc.*, **21**, 457 (1937).

[4] Buchholz, *Amer. J. Bot.*, **26**, 93 (1939).

Destruction of Cabbage White Butterflies by Birds

THE enormous numbers of 'Large Cabbage Whites' (*Pieris brassicæ* (L.)) which entered England last summer were preyed upon very frequently by birds, and this Department received many dismembered wings picked up in gardens, etc. The offspring of these immigrants have been much in evidence this month, and have also been destroyed in large numbers by birds.

Mr. A. H. Hamm, A.L.S., has kindly collected dismembered wings in a churchyard in east Oxford, and examination gives the following result:

FRONT WINGS COLLECTED OVER A WIDE AREA OF THE CHURCHYARD

	Male		Female	
	L	*R*	*L*	*R*
May 18	15	23	5	4
,, 19	4	6	6	7
,, 20	4	9	2	2
,, 21	4	1	–	3
	27	39	13	16

Hind wings are disregarded as it is often impossible to assign their sex.

COLLECTED ON BARE GROUND A FEW YARDS SQUARE IN THE CHURCHYARD

	Male		Female	
	L	*R*	*L*	*R*
May 18. 12.30 p.m.	6	4	8	7
,, 19. 1.10 p.m.	2	2	–	1
,, 20. 10.40 a.m.	1	2	–	1
,, 20. 2.10 p.m.	2	1	–	–
,, 21. 11.55 a.m.	5	5	2	–
,, 21. 4.15 p.m.	–	1	1	–
	16	15	11	9

The figures show that in four days birds had destroyed *at least* 54 males (the number of right front wings found), and 24 females (the number of left front wings found). A churchyard is not, of course, a place where females would congregate to lay eggs. The wings had been seized by the bases and pulled off; the bases are usually much rubbed, but in some cases a clear individual imprint of the bird's beak can be seen.

This is the case in 22 of the front wings and 10 of the hind wings; in most cases the imprint corresponds with the beak of a house sparrow, but in one at least it seemed to be that of a chaffinch (see Collenette, *Proc. Zool. Soc., Lond.*, Part 2, Pl. 1; 1935).

G. D. HALE CARPENTER.

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University Museum,
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May 24.

Binocular Vision

I NOTICE in the current number of the *Proceedings of the Royal Society* (vol. 128, p. 552) the question raised "Do two eyes see better than one ?"

I would refer those interested in the question to my note in the *Transactions of the Ophthalmological Society* (vol. 44, p. 183; 1924) which contains a simple demonstration of the fact that they actually do.

JOHN GRAHAM KERR.

Dalny Veed,
Barley,
Royston, Herts.

Points from Foregoing Letters

C. F. Powell, A. N. May, J. Chadwick and T. G. Pickavance describe experiments on the scattering of fast protons of about 4 Mev. energy by some light elements. The scattered particles were registered by the photographic method, which enabled the energies of the scattered particles to be determined at the same time as their angular distribution. With neon as scattering element, two groups of scattered particles were found, one corresponding to elastic scattering, the other to inelastic scattering in which the neon nucleus had been raised to an excited state. Attention is directed to the possibilities of this method for obtaining information about the excited states of atomic nuclei.

The results of exposing photographic plates for five months at altitudes of 2,130 m. and 3,660 m. in India are described by D. M. Bose and B. Chowdhry. Various tracks were found, which are believed to be due mainly to mesotrons.

F. Weigert and J. C. Mottram describe three solid modifications of 3 : 4,benzpyrene which are distinguished by their fluorescence colours, green, yellow and blue, their relative stability and their solubilities. In the presence of cholesterol the intermediate stage of the blue form is stabilized temporarily. It is suggested that a similar stabilization occurs in cells which come into contact with benzpyrene. This would make available free energy for biological action.

Considerable differences in the behaviour of quartz-covered platinum wires and plain platinum wires immersed in flame gases, are believed by W. T. David and B. Pugh to confirm the view that a proportion of the newly formed tri-atomic molecules hold an excess of intra-molecular energy which cannot be handed over to the translational degrees of freedom. In virtue of this excess intramolecular energy, a much larger dissociation obtains in flame gases than in normal gases. A. S. Leah describes experiments which lend further support to this view and shows that the observed dissociation constant varies with the amount of excess intra-molecular energy.

It has been demonstrated by R. M. Barrer that rates of diffusion of hydrogen through palladium may be independent of current density. This implies that the metal just inside the ingoing surface is saturated, which in turn requires that the rate of transport across the ingoing interface no longer controls the rate of diffusion.

M. A. Ellison describes the bright chromospheric eruptions of March 23 and 27, together with the terrestrial disturbances accompanying them.

During sugar absorption from isolated loops of the small intestine, but not during absorption of sodium chloride or amino-acids, inorganic phosphate appears in the intestinal lumen, according to L. Laszt. With selectively absorbed sugars, rate of appearance and reabsorption are different from those with other sugars. Iodoacetate as well as adrenalectomy suppress the phosphate reabsorption.

S. R. Bose reports the result of cutting out a sector from a bracket-shaped Polypore, inverting the sector and replacing it. The upper and lower surfaces of the sector developed the characteristics of the adjoining tissue.

J. Doyle finds that *Sequoia sempervirens* forms, in the young ovule, up to eight groups of gynospore tetrads, frequently tetrahedral in arrangement. These are surrounded by a tapetum, the whole appearance, unique in conifers, resembling a young pollen sac in section.

The large numbers of the destructive large cabbage white butterfly destroyed by birds are shown by the wings found lying in gardens, etc. G. D. Hale Carpenter supplies data from Mr. A. H. Hamm proving that in a certain churchyard birds had destroyed in four days at least 54 males and 24 females.

RESEARCH ITEMS

Rostro-carinates in Africa

IN an important paper (*Trans. Roy. Soc. South Africa*, **27**, Part 3, 287–319), H. B. S. Cooke and J. Desmond Clark describe, among other discoveries, an industry located at the base of the Kalahari Sand of the Victoria Falls region. This industry, which is found on and in a carstone rubble bed below the sand, is probably of Lower Pleistocene age, and is composed of typical rostro-carinates, and nosed, and other implements made from chalcedony. The flakes exhibit, usually, unfacetted striking platforms and have been struck from cores showing signs of having been afterwards used as tools. The artefacts, which are unabraded, were evidently made upon an ancient land surface existing prior to the deposition of the Kalahari Sand. This discovery of rostro-carinates affords yet another instance of the occurrence in Africa of these specimens under conditions precluding their production by glacial and other natural forces, such as are invoked by some investigators to account for these implements when found in England.

Concealing Coloration Tested by a Sparrow Hawk

LLOYD C. INGLES made use of a young Californian sparrow hawk, *Falco sparverius*, to test its acuteness in discovering and feeding upon grasshoppers (*Trimerotropis*) under different conditions (*Condor*, **42**, 104; March–April 1940). Three experiments were devised to test the protective value of the colour, and the part played by movements of the grasshoppers in revealing them to the hawk. The author concluded that when all protective resemblance to the background was removed, the hawk readily found the grasshoppers even though they did not move, for they were dead. Individuals which did not move (dead) in grass were seldom seen and captured, even after the lapse of a much longer time. Movement in the grass was probably what led most frequently to an attack, but strikes made by the hawk at insects in grass were occasionally failures, whereas no failure was recorded on nearly twice as many strikes made on a non-protective background. The author suggests that sparrow-hawks and possibly other predaceous birds may occasionally obtain their prey by flushing it from cover where it is otherwise relatively safe because of its protective resemblance and motionlessness.

Alcohol and Mental Disease

THE January issue of *Mental Hygiene* contains an interesting paper on the use and effect of alcohol in relation to alcoholic mental disease before, during and after prohibition by Horatio M. Pollock, of the New York State Department of Mental Hygiene, Albany, New York. His paper is based on the study of 662 patients admitted to State hospitals during the periods 1920–23 inclusive and the years 1936–37 inclusive. The first period covered four years of comparatively effective prohibition and the second period two years under State and local regulation. The difference in the number of first admissions in the two periods is striking, the four years under prohibition yielding only 817 alcoholic first admissions or an average of 204 per year as compared with 1,703 or an average of 852 per year in the two years under the present licence system. The writer's principal conclusions are as follows: (1) The onset of alcoholic mental disease as a rule occurs only after several years of excessive drinking, which averages about twenty-two years in men and about fifteen years in women. (2) The average age of alcoholic patients on admission to a State mental hospital is approximately forty-five years. (3) Whisky and beer are the principal beverages that cause mental disease. Whisky either alone or in combination is by far the most potent factor. (4) Although alcoholic mental disease may result from regular or from periodic drinking, nearly 70 per cent of the writer's patients were regular drinkers. (5) In the great majority of cases a fixed habit of excessive drinking with frequent intoxication preceded the onset of mental disease. (6) Reduction of efficiency and loss of position commonly precede the onset of alcoholic mental disease. (7) Impairment of physical health frequently results from excessive drinking prior to the onset of mental disease. (8) A history of delirium tremens was obtained in 23·5 per cent of the 1920–23 group and in 29·4 per cent of the 1936–37 group.

Development of Aristapedia

THE recessive character aristapedia transforms the bristle on the antenna of *Drosophila melanogaster* into a tarsus. W. Braun (*Genetics*, **25**, 143–149; 1940) has transplanted imaginal disks from normal to aristapedia flies and vice versa at an early stage of development of the larva. Transplants of aristapedial disks into normal flies from 2½ days old led to the formation of leg-like structures on the antennæ, while transplants of normal disks into aristapedia flies led to development of normal antennæ. The author studied the combination of genes affecting leg structures with aristapedia. Both dachs and thickoid affected the type of tarsus-like antennæ of aristapedia flies. On the other hand, aristaless which reduces the normal antennæ had no observable effect on the aristapedia. These facts are taken to support Goldschmidt's view that the gene aristapedia shifts the development of the antennæ to an earlier stage, and this brings the antennal disks within the influence of a leg-evocating stimulus.

Genetical Studies in *Carica Papaya*

J. D. J. HOFMEYER (*Science Bull.*, 187, South African Dept. of Agric. and Forestry; 1938) describes his experiments on sex determination in the papaw. There are staminate, carpellate and hermaphrodite plants and intergrades in this species. The author suggests that the crosses carpellate × staminate and carpellate × hermaphrodite give 1 : 1 ratios for the parental types, while the cross hermaphrodite × staminate gives a ratio of 1 staminate : 1 carpellate : 1 hermaphrodite. A simple practical hypothesis of M_1m = staminate, M_2m = hermaphrodite, mm = carpellate, where M_1M_2 and m are allelomorphic is suggested. The genes $Y : y$ for flower colour are in one linkage group with M. The linkage values are M, $25Y$. The practical applications of the studies are discussed.

Oxides of Niobium

CHEMICAL and X-ray investigations of the niobium-oxygen system have recently been carried out by G. Brauer (*Naturwiss.*, **28**, 30; 1940). They indicate the existence of three oxides with the formulæ Nb_2O_5, NbO_2, and NbO. The pentoxide occurs in at least two different forms, one of which is obtained when niobic acid, precipitated from aqueous solution, is dehydrated at 600°–800°. Powder diagrams of this form show many lines. On heating it to higher temperatures, a new form with a different X-ray pattern is produced. The dioxide, NbO_2, is obtained by reduction of the pentoxide with hydrogen or niobium. Hydrogen, even at 1600°, is unable to carry the reduction further than the dioxide stage. Contrary statements in the literature can be traced to the use of impure hydrogen. According to Goldschmidt, NbO_2 should possess the rutile structure, but powder diagrams of the purest dioxide show weak lines in addition to those corresponding with this structure. Apparently the structure is closely related to the rutile type, though not identical with it. When powdered niobium is heated with the dioxide to 1750° in an atmosphere of argon, the monoxide NbO is obtained. It is a grey solid with a metallic appearance, and crystallizes in the cubic system.

Remagnetizing Magnets used in D.C. Meters

THE commonest cause of D.C. meters registering outside allowable limits is deterioration of the strength of the field magnet. The usual error curve for a meter thus affected shows a rapidly falling line from 1/20 to full load; so even if the gearing ratio be adjusted to be correct at half load, the full load error will still be slow and the light load error fast. This follows since the driving torque is proportional to the magnetic flux density and the braking torque is proportional to the flux density multiplied by speed; thus the maximum differences of registration are at the opposite ends of the meter range; the full load error will still be slow and the light load error fast. In the *Electrical Times* of May 16, a cheap and efficient method of remagnetizing the magnets is described by R. Callender which should lead to appreciable economies in service. The meter element is taken out of the case and the register removed. A large current is then 'flashed' round the magnet; the field strength being now too great, it is reduced slightly to near the normal working value. This is accomplished by passing instantaneously a reduced current in the reverse direction. This is effected by inserting a suitable copper fuse in the circuit and proceeding to 'flash' as before. The meter element must then be laid aside for a month or two before it is reassembled. In order to bring the magnet field strength to normal working value, the magnets are further artificially aged by passing a short-circuit current through the meter. This should be done twice when the meters are connected in series for test, suitable fuses being used. The first operation reduces the field strength by about two per cent and the next by about a half per cent. Subsequent short circuits should have little, if any, effect.

Absorption of Hard Cosmic Rays and Mesotron Decay

IT has several times been suggested that the observation that the absorption of hard cosmic rays is less in a medium of low density such as air than in the same mass of a denser material may be explained by the spontaneous decay of the mesotron into an electron. The loss of mesotrons by decay becomes appreciable when the time taken for the mesotron to traverse the absorber becomes comparable with the mean life of the particle. The experimental evidence in this sense has been made much more definite by the work of B. Rossi, N. Hilberry and J. B. Hoag (*Phys. Rev.*, **57**, 461; 1940). The vertical intensity of hard rays was measured by a counter system containing 13 cm. of lead. The intensity was measured at several heights up to 4,300 metres, and the absorption in a thick graphite block placed above the counters was measured at the higher station and thus compared directly with that of air. Carbon was chosen as having an atomic weight and number close to that of air; the effect of scattering and of showers was carefully considered. The results showed the excess absorption referred to above, and the average life of the mesotron was found to be about 2×10^{-6} sec. It was not found possible to establish the increasing range of the mesotrons predicted by theory as the mesotrons become more energetic on filtration through the atmosphere; but it is not certain that a sufficient increase in mesotron energy by filtration actually occurs in the range studied. E. Fermi (*Phys. Rev.*, **57**, 485; 1940) finds theoretically that the loss of energy of any fast particle due to ionization of the atoms in its path is less in a dense than in a rarefied substance. This effect is due to the screening effect of the polarization of surrounding molecules. It is in the same sense as the effect attributed to the decay on the mesotron in cosmic rays. A calculation on classical lines indicates that the effect is large at very high particle energies. At moderate energies the effect is not sufficient to explain the results obtained by Rossi, Hilberry and Hoag, which are therefore probably correctly attributed to mesotron decay.

Electric Potential Gradient of the Lower Atmosphere

MEMOIR No. 8 of the Commonwealth Solar Observatory, Canberra, describes the results of the potential gradient observations made at Mount Stromlo during the years 1933–38. The electric potential gradient of the lower atmosphere at this station has now been the subject of continuous study for twelve years. C. W. Allen, in discussing the latest results, deals chiefly with the diurnal variation and its relation both to local and to world-wide factors. The local diurnal variation consists mainly of a sharp increase of gradient at sunrise to a maximum 5 hours later, and then a gradual decrease until the next sunrise, interrupted only by a slight depression at the intervening sunset. Its effect on the observations is nearly eliminated by examining only days of "continuous wind", that is, days on which the wind is constant in direction with a minimum velocity 5 m.p.h. for more than twenty-four hours. Correction of the Canberra observations for the local variation gives a "world variation" agreeing well both in phase and amplitude with ocean observations: a sharp minimum of about 84 per cent of the mean value occurs at 4h. U.T. and is followed by a slow rise to a maximum (120 per cent of the mean value) which is retarded from 18·5h. U.T. in January to 20·5h. U.T. in July. The curve showing the annual variation at Mount Stromlo indicates that the gradient is at a minimum in May and at a maximum in August; the elimination of local variations, however, removes both these, and the resulting curve is featureless. There is no evidence of any secular variation with the sun-spot cycle.

BONE AND STONE INDUSTRIES OF EARLY MAN IN CHINA

SINANTHROPUS

FOR the first recognition of the fact that Sinanthropus had made and used implements of bone the archæological world is indebted to the Abbé Breuil. Before 1930, it was not known that the Choukoutien cave, in which the osteological remains of Peking man had been discovered, was an archæological site; but in that year Dr. Breuil recognized that the base of the antler from the cave, shown to him in Paris, had been burnt and fashioned into a tool by blows of a stone implement. Further discoveries of quartz flakes and burnt bones followed, and were in turn succeeded by the discovery of the rich cultural layer at the base of the Kotzetang in 1931. A visit to the site in that year by Dr. Breuil led to the identification of a large number of tools fashioned of bone or antler; and as these were not universally accepted without question, he was invited to make a further and more detailed study of them, of which the results are now made available*. It is to be noted that material found later than 1934 is not included in the report.

For the present purpose, the significant facts of the Choukoutien site may be summarized as follows: Locality 1, a completely collapsed cave filled with debris to a depth of 50 metres, shows five horizons each of which yields evidence of Sinanthropus. At the base of Level 4 is the famous cultural layer in Kotzetang. Three further sites only have yielded cultural remains of Sinanthropus age: Locality 13, older than Locality 1, but only a few flakes and a single but fine chert artefact; Locality 15, possibly connected with the eastern slope of Locality 1 and containing a remarkably rich and advanced lithic industry; and Locality 4, still under excavation and yielding, at present, nothing but a few atypical broken stones.

No remains other than those of Sinanthropus occur from top to bottom of the deposits of Locality 1, and there is, therefore, no valid reason for assuming the existence of another inhabitant of the cave, as do some prehistorians. Nor does the predominance of cranial remains support the suggestion of the practice of head-hunting, which belongs to a more advanced stage of culture, while in the only certain prehistoric example known (Ofnet, Bavaria) in all the specimens, as a rule young or feminine, the first two cervical vertebrae are retained and show marks of having been sectioned by a flint. At Choukoutien only one atlas, loose, has been found. The explanation here offered is that it is a deformation, an aberrant evolution from reverence for the family skulls as ensuring ancestral protection.

Certain criteria distinguish animal action on bones from that of man. The most likely to give rise to uncertainty are the hyæna, the beaver and the porcupine. The crushing action of hyæna jaws is difficult to distinguish in effect from the hammer-anvil blow of man, though a hyæna never splits a bone lengthwise. A single bite by a beaver or porcupine may make a double or single incision which resembles a notch made by a metal tool, while their action in gnawing the end of a bone may look like a point chopped by man. This is the origin of the so-called 'worked' elephant bones of Piltdown.

From the point of view of the toolmaker, three stages in fossilization are to be distinguished: (*a*) when still fresh the bone breaks cleanly and can be used readily for implements; (*b*) in the first stage of fossilization disintegration predominates over mineralization, bone is brittle, tends to crumble and has an irregular fracture; (*c*) complete fossilization renders it capable of being broken cleanly and sharply, but the outside and inside being usually of a different colour, breaks can easily be seen. The bones found at Choukoutien all belong to Stage (*a*).

In considering the industries of the earlier palæolithic periods, while it is admitted that, in addition to stone, man must have used wood, which has perished, it is usually overlooked that in bone man had at hand a convenient and adaptable material most of which also must have disappeared. The bone industry was first developed but was not invented in Upper Palæolithic times.

From the days of Sinanthropus, man has used horns of antelope, gazelle, goat and young ibex (ox horns being too big) antlers and stag-horns, skulls, jaw-bones, long bones, whole or broken, fragments of diaphyses, and flakes, short bones, chiefly astragals, carpus, tarsals and phalanges, vertebrae, ribs, iliac bones and shoulder blades, which in the Upper Palæolithic show evidence of having been used as shovels or scrapers.

Thus bone was used whenever a hard substance was needed, exactly like any stone, from the dawn of human toolmaking. The facts at Choukoutien confirm exactly observations at Castillo, Santander, Spain, as against the contention that the palæolithic bone industry is confined to the Upper Palæolithic and some rare Mousterian objects.

The material used at Choukoutien and identified includes horns and skulls of deer and ruminants, jaw-bones and teeth of deer, wild boar, fragments of elephant ivory, maxillæ of Carnivora (hyæna, leopard, tiger, bear), body and leg bones, including shoulder blades, humerus, radius, femur and tibia of deer, horse, rhinoceros, hyæna, bear, etc. The anatomical origin of a large number of flakes is difficult to determine.

An interesting and important point to emerge is that the state of the deer antlers points to a seasonal migration among them. All except two of the antlers of Pseudaxis are attached to the skulls and must have been so born when the animal was killed, while in Euryceros the majority of antlers have been shed. The antlers being shed at the beginning of winter after the rutting season, evidently the Euryceros migrated from the highlands to avoid the cold and occupied the country of the Pseudaxis, which retired before them until they retreated in the following year. The absence of half-grown antlers suggests that during the five months until the end of summer, Sinanthropus either left his cave or did not eat animals.

THE UPPER CAVE

The Upper Cave at Choukoutien, when discovered in 1930 during the search for Sinanthropus remains, was considered of relatively little importance; but when it was fully excavated in 1933–34, it was found to be of unique character in Chinese prehistory. In it were found not only artefacts of an Upper Palæolithic culture, but also the skeletal remains of a number of individuals representative of Upper Palæolithic man in China, who hitherto had been unknown. The results of the excavation of the cave are to be described in a series of monographs, of which that dealing with the archæology by W. C. Pei is the first to appear*.

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* Bone and Antler Industry of the Choukoutien Sinanthropus Site. By Henri Breuil. Translated by Miss M. E. Boyle. *Palæontologia Sinica*, N.S.D., No. 6, Peking, 1939, pp. 40+26 plates.

The Upper Cave, previous to excavation, was completely covered by the superficial soil of the hill and filled with deposits, consisting of a grey loam mixed with fragments of collapsed rock. This was completely removed down to the red and hard breccia of the Choukoutien formation, in which further excavation would have been unprofitable. The cave consists of an upper room, a lower room and a lower recess, a narrow cavity three metres long and one metre wide, forming the lowest part of the cave. Five cultural layers were distinguished. It is possible that the Lower Room, in which human remains, including three complete skulls, were found, may have been a burial place only and not a dwelling site. In the lower recess an accumulation of animal bones and skeletons alone was found.

Occupation lasted up to the complete filling of the upper room. The Upper Cave industry is characterized by a poorly developed, or at least poorly represented, lithic industry in which chert, sandstone, quartz, all foreign to the site but found in the vicinity, are in use. The types of implements include scrapers, choppers, as well as pebble implements. A notable feature is the use of personal ornament-perforated pebbles, stone beads with large perforation and one ground surface. The bone, antler and shell industries, mostly reserved for ornamental purposes, are most characteristic, and being usually left in natural shape are typical of a 'primitive' industry. A remarkable find is a bone needle, such as was not known hitherto to have occurred in China before Neolithic times. The technique of polishing is to be observed on a deer antler and the jaw-bone of a Sika deer.

As a whole, the Upper Cave industry is clearly ranged within an Upper Palæolithic stage, but on comparison with its European equivalents it shows a mixture of relatively primitive and relatively advanced characters. It is likely that these artefacts represent an isolated culture of their own, indebted in part to a northern 'palæarctic' culture, in part to a Pacific culture sheet extending from Malaya to Manchukuo. It may on palæontological and archæological grounds be regarded on the Eastern equivalent of the Western Late Magdalenian.

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* The Upper Cave Industry of Choukoutien. By Pei Wen Chung. *Palæontologica Sinica*, N.S.D., No. 9, 1939, pp. 41+8 plates.

FOOD PRODUCTION WITHOUT ARTIFICIAL FERTILIZERS

By Ysabel Daldy

AN ACCOUNT of a valuable experiment in the feeding of schoolboys on vegetables and fruit grown from soil manured exclusively by humus is published by Dr. G. B. Chapman, of the Physical and Mental Welfare Society of New Zealand, Incorporated (Burnock Publications, Auckland, 1939). The locale of the experiment is the Mount Albert Grammar School hostel, the subjects being some sixty boys, teachers and staff. At the time of the inception of the experiment (1936), the dietary at the hostel was liberal, being well above the customary standard for boarding-schools; yet the boys consistently suffered (as was the case in other New Zealand schools and institutions) from colds, catarrh, septic tonsils, epidemics of influenza, dental caries and other preventable complaints. The whole of New Zealand's food supplies are grown from soils manured by the ordinary chemical fertilizers.

Dr. Chapman opened his campaign in 1936 by delivering a few short lectures to the resident teachers and boys, advising the growing of the hostel's fruit and vegetables from soils to be treated by properly prepared humus. He was successful in arousing the interest of the teachers, the boys, the matron and the staff. The reform was put in hand and the change-over made from 'chemically grown' fruit, salads and vegetables to the 'naturally produced' foods now in use at the hostel. At the present time, approximately an acre of land is under cultivation for the benefit of the hostel, to the soil (black volcanic) of which no chemical or artificial fertilizers of any kind have been applied. The area in question is supplying the greater proportion of the green vegetables, salad-greens, pumpkins, kumaras, root-vegetables and fruit required by a household of some seventy-seven persons. The following general report of progress in health since the time of the change-over has been submitted by the matron of the hostel (pp. 4–6, "Menus and Recipes", Chapman and Lowe, 1939):

"The first thing to be noted, during the twelve months following the change-over to garden produce grown from our humus-treated soil, was the declining catarrhal condition among the boys. Catarrh had previously been general and, in some cases, very bad among the boys. In specific cases the elimination was very marked and in many cases complete. There was also a very marked decline in colds and influenza. Colds are now rare and any cases of influenza very mild. Coming to the 1938 measles epidemic, which was universal in New Zealand, the new boys suffered the more acute form of attack; while the boys who had been at the hostel for a year or more sustained the milder attacks, with a much more rapid convalescence.

"During the past three years there has been a marked physical growth and development during terms of heavy school work and sport [actual heights and weights are quoted]. In some cases boys go through a period of indisposition for several weeks after entering the hostel. This would appear to indicate that the method of feeding causes a certain detoxication period which, when cleared up, does not return. Excellent health gradually ensues in all cases, and is maintained. There are fewer accidents, particularly in the football season, which would possibly indicate that the foods in use contain the optimum amount of minerals and vitamins, thus ensuring a full development of bone and muscle and a greater resiliency to fractures and sprains. The satisfactory physical condition described is maintained during periods of rapid growth and development of mind and body. Constipation and bilious attacks are rare. Skins are clear and healthy, while the boys are unceasingly active and virile.

"Since the change to naturally grown garden produce, the periodical reports in regard to the boys' dental condition have been more than gratifying." This point needs emphasis, as New Zealanders continue to show a poorer dental condition than is the case in most other countries of the world. In connexion with present-day examinations of young men volunteering for service in the War, the Hon. W. E. Parry, Minister of Internal Affairs, has published the fact (*New Zealand Herald*, October 2, 1939) that forty per cent of the recruits are found to be temporarily unfit through defective teeth.

Dr. Chapman has now interested the Government of New Zealand in the results he is obtaining from a dietary inclusive of naturally grown fruit and vegetables; and the Mount Albert Grammar School hostel experiment will in future be continued under the auspices of the New Zealand Health Department.

ORIGIN OF THE VERTEBRATE COELOM

By H. Barraclough Fell,

(Shirtcliffe Fellow, University of New Zealand)

RECENT years have witnessed a series of fundamental changes in our ideas on embryology, these changes being the expression of what had formerly been a growing mistrust of some of the generalizations of the nineteenth century. Thus de Beer[1], in the course of a convincing essay, set forth strong evidence to show that the theory of recapitulation cannot be accepted in its original form. Again, Oppenheimer[2] has recently reviewed the results of research on the earlier stages of development, and her conclusion is that ". . . the doctrine of the absolute specificity of the germ-layers as enunciated in the last century must be abandoned". So early as 1894, Garstang[3] had presented evidence leading him to believe that the ancestor of the chordates could be found in an animal closely approximating to the present larval forms of echinoderms. One important consequence of Garstang's work in this direction is that it has led to the recognition of the fact that evolution can act on the earlier stages of development; the original recapitulation theory supposed that evolution worked only on adult forms, tacking on, as it were, additional phases at the end of ontogeny. The echinoderm theory has received ever-increasing attention, until now it may be regarded as the most important attempt to solve the problem of the ancestry of the chordates.

The theory in its present form, however, seems to suffer from one serious drawback, in that it supposes that the schizocoel of vertebrates arose from the enterocoel of the echinoderm larva. It has been urged that the formation of the anterior coelomic pouches from the archenteron in Amphioxus provides evidence of the enterocoelous nature of the original vertebrate coelom. Against this it must be adduced that all known vertebrates have now a schizocoel, and that it is only Amphioxus and its related forms that have an enterocoel. As Amphioxus is in so many ways highly specialized, there can be no safe ground for believing that its mode of derivation of the coelom is primitive. Furthermore, there are other groups of invertebrates, notably the annulates, in which there are strong features of resemblance to the vertebrates, and at the same time a schizocoelous development of the coelom.

It is clear that the above objection applies only so long as we regard the coelom of echinoderms as being necessarily an enterocoel—and, up to the present, there appears to have been no suggestion that this may not be the case. Now, the formation of hollow structures by derivation from pouches does not on the face of it appear to be primitive. Rather it would seem to be a later 'short-circuiting' of some more primitive method which must have involved first the formation of a mass of tissue (in this case mesoderm, derived from endoderm of the archenteron), and secondly the excavation therein of a cavity (in this case the coelom). In the same way it has already been suggested by other workers that the invaginative method of formation of the endoderm and its enclosed cavity the archenteron may be a later short-circuiting of a more primitive scheme in which there first arose a solid mass of endoderm (by migration, delamination, or some other means), and then later the archenteron was excavated in this mass. Invagination in the case of the latter instance, and pouch-formation in the case of the former, are to be regarded as later products of evolution, enabling the final result to be attained in shorter time. One reason for being unable to regard as primitive the pouch method of formation of the coelom is that it is difficult to imagine the incipient stages of such a process, unless we postulate some such previous development as has been outlined.

So far, no practical evidence has been forthcoming to confirm that the enterocoel of the echinoderms is not the only type of coelom found in that group, nor has there been any concrete evidence to show that the echinodern enterocoel may not be primitive. However, in a paper now in the press[4] it will be shown that the coelom actually does arise by splitting in the mesoderm in a New Zealand ophiuroid. The fact that this species (as yet unidentified) has an unusual development was first discovered and recorded by Kirk[5] in 1916, but the schizocoelous origin of its coelom has only recently come to light. This unexpected feature led me to consult a paper by Russo[6] published as long ago as 1891, in which he claimed to have found that the coelom in the ophiuroid *Amphiura squamata* arose by splitting in mesenchyme. Owing unfortunately to his inaccurate description and figures, Russo's results were ignored by subsequent workers; but actually he was never proved to be incorrect. His statements, of course, accorded ill with the recapitulation theory then holding sway. I am at present engaged upon a re-investigation of the development of *A. squamata*, and the preliminary results seem to confirm that Russo was indeed right in assuming the schizocoelous origin of the coelom, though in other matters he was mistaken. Thus in one echinoderm at least, and probably in two, there is a schizocoel. In all likelihood the same will be found to be true of other species too.

There are some relevant facts which must be mentioned here. Both Amphiura and Kirk's ophiuroid are species with yolky eggs. In both species the development is shortened. Thus Amphiura has only a vestigial larva within the bursa of the parent, while in Kirk's species there is no larval stage whatever, the development being direct. The latter species, unlike Amphiura, is not viviparous.

It may be argued that the presence of yolk material in the eggs of these two species, and the viviparous habit of the former, render them too specialized to be regarded as being capable of giving rise to anything else in evolution. Against this the following facts must be considered:

(1) Yolky eggs are very common in echinoderms. The fact that the development of so few yolky species is known may well have given us an incorrect idea of echinoderm embryology in general.

(2) Kirk's ophiuroid is not viviparous, and yet has a more direct development than Amphiura, which is viviparous. Therefore viviparity cannot be regarded as a cardinal factor in producing direct development, unless we suppose that Kirk's species was formerly viviparous and then lost the habit.

(3) Most of the lower vertebrates have more or less yolky eggs, together with (invariably) a schizocoelous coelom. This fact is to be considered in relation to the same conditions prevailing in the two echinoderms cited.

(4) Amphioxus, on the other hand, has a non-yolky egg, and, as might be expected from the foregoing, has an enterocoelous coelom.

(5) The widespread occurrence of yolky eggs in so many different classes renders it doubtful whether yolk really is a specialization after all. In any event, the heavily yolked reptilian egg is held to have given rise to the mammals (in whose eggs the yolk is so reduced). Therefore it should not be difficult to imagine an echinoderm larval form, with yolk-material in its tissues, giving rise to other forms.

There is a difficulty in that it appears, from the limited evidence at present available, that suppression of the larval stage tends to accompany the presence of yolk. It is not clear as yet, therefore, whether an echinoderm larva can itself possess a schizocoel, but it has been shown that a schizocoel can occur in the life history. In my view, the significance of the association of yolk in echinoderms and chordates with a schizocoelous development of the coelomic cavities is this: the presence of inert food-material in the endoderm tends to retard the changes of organization of the latter. The yolk for physical reasons makes the cutting off of enterocoelous pouches an excessively slow process. Hence the more primitive method is reverted to, by which the coelom arises as a schizocoel in a mass of mesoderm.

Since writing the above, it has been found that in the embryo of *Ophiomyxa brevirima* the region of the future coelom is first occupied by an extensive zone of solid mesenchyme. The obvious similarity to the condition in *Amphiura squamata* and in Kirk's ophiuroid leaves little doubt that the coelom in this form must also arise as splits in the mesenchyme mass. Here, too, the embryonic tissues are laden with yolk. A fuller account will be published elsewhere.

[1] de Beer, G. R., "Embryology and Evolution", Oxford (1930).

[2] Oppenheimer, J. M., "The Non-Specificity of the Germ-Layers", *Quart. Rev. Biol. Sci.*, **15**, 1 (1940).

[3] Garstang, W., "Preliminary Note on a New Theory of the Phylogeny of the Chordata", *Zool. Anz.*, **17** (1894).

[4] Fell, H. B., "The Direct Development of a New Zealand Ophiuroid", *Quart. J. Micro. Sci.* (in the press).

[5] Kirk, H. B., "On the much-abbreviated Development of a Sand-star (*Ophionereis schayeri* ?)", *Trans. N.Z. Inst.*, **48** (1916).

[6] Russo, A., "Embriologia dell' *Amphiura squamata*", *Atti. R. Acad. Nap.*, Ser. 2, **5** (1891).

POST-GLACIAL VEGETATION OF ENGLISH FENLAND

A STRATIGRAPHICAL sequence of lower peat, fen clay, upper peat and upper silt is characteristic of the whole of the southern part of the Fenland. The corresponding sequence of post-glacial vegetation successions throughout the area and their correlation with archæological horizons is described by H. Godwin (*Phil. Trans. Roy. Soc.*, **230**, No. 570, Feb. 1940).

Evidence from pollen analysis methods shows that birch, which along with pine originally dominated the area in Pre-boreal times, was replaced in the Boreal period by pine; whilst extensive elm and oak woods developed with an undergrowth of hazel and with alder and lime in favoured places. These forests were occupied by Tardenoisian people, as evidenced by microlithic flints from weapons and tools. Oak, alder and lime predominated during the succeeding wetter Atlantic period, and the post-glacial forests reached their maximum development, affording shelter for late Mesolithic and Neolithic peoples.

Within the Neolithic period the Fenland area became generally water-logged and fen peat began to accumulate, embedding the tree bases and leading to their destruction and to the transition to a sedge fen with wooded tracts of alder, willow and birch. Drier Sub-boreal conditions led to renewed development of woodland, to be succeeded by extensive invasion by the sea and the conversion of the whole area into a brackish lagoon. The deposition in this shallow lake of silt and clay gave rise to the thick deposits of fen clay overlying the lower peat.

In the Bronze Age, freshwater fen was re-established and a new mantle of peat formed. Towards the end of the period dry fen woods, across which pre-historic man passed freely, had once more extended across the full width of the fens. At 500 B.C. the colder and wetter conditions made the area uninhabitable for, in contrast with the Bronze Age, no trace of Iron Age man has been found.

The effect of climatic deterioration was heightened during the Roman period by a further phase of marine invasion giving rise to extensive coastal salt marshes of silt and raised river banks which penetrate far into the peat country. Romano-British agriculture spread along the silt banks of the river channels, and the first drainage operations date from this period. Between then and the effective drainage of Fenland in the seventeenth to the nineteenth centuries no trace is available of human occupation. The present change in relative land and sea-levels points to a further marine invasion.

SEVENTY YEARS AGO

NATURE, vol. 2, June 9, 1870

The New Australian Mud-fish

P. L. SCLATER, F.R.S., secretary of the Zoological Society, describes and illustrates the newly discovered Australian mud-fish, basing his account on a paper sent to the Zoological Society by Mr. Gerard Krefft, curator of the Australian Museum, Sydney, who had named the fish *Ceratodus forsteri*. The general resemblance of the fish to Lepidosiren is remarked upon, and it is said to be so common that it is known as the "Burnett" or "Dawson salmon", from the two Queensland rivers in which it is principally found.

In conclusion, Mr. Sclater hopes that "this short notice may have the effect of calling the attention of some of the colonists of Queensland to the wonderful nature of this relic of the Devonian epoch that is now swimming about beneath their noses, and that they will cease, for the present at least, to kill it and eat it as 'salmon'. Any specimens that may 'rise to their fly' should be carefully kept out of the way of the cook, preserved in alcohol and transmitted to the British Museum or some other scientific institution".

Fizeau's Experiments on "Newton's Rings"

PROF. G. CAREY FOSTER, F.R.S., compares the wave-lengths of the sodium doublet as determined by Ångström with observations made by Fizeau by the method of Newton's rings.

Fizeau produced Newton's rings by means of a convex lens and a plane glass illuminated "by the yellow flame of spirit of wine containing a little common salt". It was found that, on separating the lens from the glass, the rings contracted, disappeared at the middle, and were replaced by new rings. In this way, nearly 500 rings were counted, after which rings ceased to be visible; then after a period, a further 500 rings became visible again, and so on. The explanation is that the yellow light used consists of two parts of slightly different refrangibility. Each part is capable of producing a set of rings, and when they are put together, they nearly, but not quite, fit each other. The effect can be explained on the "undulatory theory" of light, and gives results in good accord with those derived from Ångström's wave-length measurements.

The Natural History Collections

IN 1858, a memorial on the organization of the British Museum Natural History Collections was submitted to the Chancellor of the Exchequer by a group of four zoologists and five botanists. Nothing was done at the time, but the subject having again come before Parliament, the memorial was printed in NATURE in full, and readers, especially botanists, were asked to communicate their views to the Editor.

AT a meeting of the German Chemical Society on May 23, A. Baeyer and M. Emmerling reported on the transformation of isatin into indigo. When treated with phosphorus in "chloride of acetyle or of phosphorus", isatin forms indigo-blue and indigo-red.

THE council of the Society of Arts has awarded the Albert Medal to M. F. de Lesseps, "for services rendered to arts, manufacturers, and commerce, by the realization of the Suez Canal".

MR. JOULE has been elected to the Section of General Physics of the Paris Academy of Sciences.

FORTHCOMING EVENTS

Monday, June 10

ROYAL GEOGRAPHICAL SOCIETY, at 5 p.m.—E. J. Wayland "Forest versus Desert in Eastern Africa".

Tuesday, June 11

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5 p.m.—E. J. Wayland: "Some Aspects of Uganda Prehistory".

ZOOLOGICAL SOCIETY OF LONDON, at 5 p.m.—James Fisher: "The Status of the Fulmar in the British Isles". A Symposium on Taxonomy and Palæontology (J. A. Moy-Thomas: "Problems of Palæontological Classification"; E. B. Ford: "Palæontological Classification from the Geneticist's Point of View"; Dr. L. R. Cox: "Problems facing the Invertebrate Palæontologist").

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

INSTRUCTOR IN MECHANICAL ENGINEERING WORKSHOP PROCESSES AND PRACTICE—The Secretary for Education, County Education Offices, Northampton (June 12).

TECHNICAL ASSISTANTS (MECHANICAL ENGINEERING) IN THE DIRECTORATE OF AMMUNITION PRODUCTION—The Secretary, Ministry of Supply (S.E.3.b), Adelphi, W.C.2 (quoting Appts. 034/S.E.3.b) (June 12).

PROFESSOR OF MATHEMATICAL PHYSICS—The Secretary and Bursar, University College, Dublin (June 15).

HEAD OF THE CHEMISTRY DEPARTMENT—The Clerk to the Governors, Technical College, Normanton Road, Derby (June 15).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Principal, Technical College, Kingston-upon-Thames (June 18).

LECTURER IN EDUCATION—The Acting Secretary, University Court, Glasgow (June 20).

A METALLURGIST OR A METALLURGICAL CHEMIST at the Medway Technical College, Gillingham—The District Education Officer, Fort Pitt House, New Road, Rochester, Kent (June 22).

LECTURER (MAN OR WOMAN) IN THE DEPARTMENT OF PURE AND APPLIED SCIENCE, FOR BIOLOGY, ANATOMY AND PHYSIOLOGY—The Registrar, Loughborough College, Loughborough, Leicestershire (June 22).

GRADUATE ASSISTANT MASTER TO TEACH MATHEMATICS AND SCIENCE—The Principal, Technical Institute, Beckenham Road, Beckenham (June 24).

ASSISTANT ENGINEER TO THE CENTRAL ROAD BOARD, BARBADOS—The Secretary, Central Road Board, Bridgetown, Barbados (July 13).

EDUCATION LECTURER AT THE PORTSMOUTH TRAINING COLLEGE—The Registrar, Municipal College, Portsmouth.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 5: The Periodic Lamé Functions. By Dr. E. L. Ince. Pp. 47–63. 1*s*. 6*d*. Vol. 60, Part 1, No. 6: The Estimation of Factor Loadings by the Method of Maximum Likelihood. By D. N. Lawley. Pp. 64–82. 1*s*. 6*d*. Vol. 60, Part 1, No. 7: Further Investigations into the Periodic Lamé Functions. By Dr. E. L. Ince. Pp. 83–99. 1*s*. 6*d*. Vol. 60, Part 1, No. 8: Reciprocity, Part 2: Scalar Wave Functions. By Prof. Max Born. Pp. 100–116. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [245

Ministry of Health. International Agreement, Brussels, 1924. Venereal Diseases: Centres in the Ports at Home and Abroad where Seamen can obtain Treatment. (List 7a, revised.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net. [275

Other Countries

Southern Rhodesia: Geological Survey. Bulletin No. 35: The Geology of the Country around Bulawayo. By F. L. Amm. Pp. viii+307+27 plates. (Salisbury: Government Stationery Office.) 9*s*. 9*d*. [275

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1939. Pp. 48. (Salisbury: Government Stationery Office.) [275

Common Marine Food-Fishes of Hong Kong. By G. A. C. Herklots and S. Y. Lin. Second enlarged edition. Pp. ii+89. (Hong Kong: G. A. C. Herklots, The University). 2.50 dollars. [275

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Vol. 145 SATURDAY, JUNE 15, 1940 No. 3685

THE WAR EXTENDED

SIGNOR MUSSOLINI'S decision of June 10 has inspired the contempt of all freedom-loving peoples. That two men are able to decide the fate of about a hundred and fifty million people, and challenge, directly or indirectly, the peace and prosperity of the rest of the world with little or no reference to other authority, is perhaps the greatest blow to human dignity in history. But this is not the time for recrimination and criticism. The challenge must be met now.

On the same day, Mr. Duff Cooper, Minister of Information, spoke of this new tragedy, pointing out that there is so much that we all like and admire in Italy and the Italian people. All scientific people will contribute to this view. It is scarcely necessary to mention the fruitful fields for archæological and historical studies offered by that country, the first marine biological station at Naples, the important contributions to the mathematical and physical sciences made by Italy over a period of centuries. Yet it is a sad reflection on modern civilization that we must now anticipate an "increase in the number of ruins for which Italy has long been famous". Much, far too much, of Europe is already in ruins ; there is not the slightest reason or excuse for opening out the vista of this hideous carnage. "No war has ever been declared with so little provocation as this. Italy had no quarrel with Great Britain or with France, and had made no claim which had been refused." Every problem could have been solved by scientific and honest debate.

M. Reynaud, on this same sad day, asks : "How shall we judge this act ? France has nothing to say. The world which is looking on will pass judgment." The lovers of freedom and of democratic government have passed their judgment in no uncertain terms. The highest moral authorities in the world, including the Pope and President Roosevelt, had repeatedly tried, but in vain, to prevent the extension of war, which is opposed to all ethical principles and to human solidarity.

Two great democracies, two great Empires, are fighting for their freedom and that of other countries—indeed of the world. After all else had failed, they were compelled to meet force with force. To those "evil things" which they have been fighting for ten months are now added more evil things. But great inspiration is forthcoming to those two democracies from a third. There has been no doubting the moral attitude of the United States since hostilities began ; but on the day of Italy's declaration, President Roosevelt, at the graduation exercises of the University of Virginia, spoke emphatically of Italy's scorning "the rights and securities of other nations".

"On this tenth day of June 1940," he said, "from this University, founded by the great American teacher of democracy [Thomas Jefferson, third president of the United States], we send forward our prayers and our hopes to those beyond the seas who are maintaining with magnificent valour their battle for freedom." The Americans have now seen beyond any shadow of doubt the ascendancy of the philosophy of force in country after country where free institutions and individual liberty to search for truth and to express opinion were once maintained ; where control of machines was retained in the hands of mankind as a whole. "Neither those springing from that stock nor those who have come hither in later years can be indifferent to the destruction of freedom in their ancestral land across the sea", the President said.

For years NATURE has striven hard for intellectual freedom in thought, word and action. We can never subscribe to any theory of nationalism in science; and therefore men of science can now look with deep satisfaction on the quick passing of the isolationist policy so recently advocated by certain groups of Americans, but now so clearly repudiated by their President.

The British and the French are not nations fighting nations, but freedom-loving peoples actively opposing the forces of evil and falsehood. In this hour of need it is a comfort to know that the United States is now to "extend to the opponents of force the material resources of this nation".

Unity in the common cause has been achieved within the British Empire and within the French Empire, and also between the two. Movement towards the achievement of such unity throughout the democratic States of the whole world is increasing in momentum, a movement in which science is playing an important part. In the leading article in NATURE of May 25, p. 796, attention was directed to the brilliant contributions to our war effort that many men of science of the Allies are making in the Fighting Services and research organizations immediately connected with them, to say nothing of the many scientific workers and teachers carrying on at the home front. (Alas, the work of many others in Poland, Norway, Holland and Belgium has been immobilized by the brute force which has temporarily overcome them.) But now to these efforts will be added much from our colleagues in the United States.

When "the control of machines was retained in the hands of mankind as a whole", untold benefits accrued, but under the system of force in the hands of irresponsible conquerors, the machine becomes master, with mankind a servant and victim. It cannot be denied that science has been a major element in forcing such a grievous issue resulting in this holocaust. But the conscience of science is clear. She offers man a rope to skip; she cannot be blamed if he chooses to hang himself with it. On the other hand, science is willing, nay eager, to assist him along the path of prosperity and happiness which she has helped to provide.

Thus, when Great Britain declared war on Germany, the voice of science was raised. In NATURE of September 9, 1939, p. 455, we emphasized that "It is the duty of the man of science to lay aside his just misgivings whether the greatest force of the human intellect should thus be harnessed to the forces of destruction. . . . The interests of pure science as an intellectual pursuit and discipline must remain in abeyance." The voice has proved strong and it did not cry in a wilderness. Science is being utilized in this war effort as never before. And now, we say, this voice must be even stronger. Our energies must be directed without remission to the cause of freedom. British and French men of science in collaboration, with the moral sympathy and active assistance of their American colleagues, must give their all, even at the expense of sacrificing or modifying their cultural pursuits. Thus alone can we hope for the overthrow of brute force and the speedy initiation of the period of reconstruction which shall enshrine the great prize of freedom.

CO-ORDINATION IN NATIONAL FOOD POLICY

THE new ministries established to deal with war-time problems must find it necessary to improvise policies and, since decisions are urgent, to adopt short-term arrangements for dealing with the manifold problems they are called upon to handle.

Food concerns every one of us. Food production and the trade in foods give employment to more people than any other form of industry or service. Hence it was only to be expected that the Ministry of Food should have become a target for a large volume of criticism.

As has already been pointed out in the leading article in NATURE of March 30, food policy has never been in peace-time the principal responsibility of any minister or of any Government department. Food production has been considered from the point of view of the farmer, imports of food as factors in commercial policy, food distribution as it related to the wholesale or retail trade. The Ministry of Health, largely preoccupied with the problems of local government, held a watching brief for the protection of the consumer from impure or adulterated food; but, although committees had been set up to consider nutritional requirements, there had been no attempt to co-ordinate ricultural, trade and health considerations into national food policy.

Since food supplies are one of the most vital ctors in national defence, the war-time Ministry Food, developed from the nucleus of the pre-war ood (Defence Plans) Department, had rapidly to olve such a co-ordination, and to do this simul- neously with the taking of decisions on every parate question concerning food.

The House of Commons, following a precedent the War of 1914–18, called into being a Select ommittee of the House to consider National xpenditure. This Committee consists of thirty- vo members of the House drawn from all parties. s main task is to consider whether full value is eing obtained from Government expenditure, and hether proper regard is being paid to economy. uch tasks inevitably involve the consideration of olicy. The fourth report of the Select Committee eals with the work of the Ministry of Food*. he functions of the Ministry are described, and ne report then deals with considerable frankness ith a number of matters of the greatest interest o national welfare and to the efficiency of our war ffort. Ministers of the previous Government have tated that Government policy was to subsidize ood in order to prevent an undue rise of prices. he Select Committee is clearly critical, not of his objective, but as to whether the subsidies hich are actually being given should be mainly egarded as contributions from the State to keep own food prices, since their main effect appears to e to increase the assistance given to United Kingdom farmers. The report contains paragraphs dealing with milk, bacon, meat and wheat, from hich it appears that the Committee tended to egard the sums, aggregating over £40,000,000, eing found by the Government for these foods as eing principally beneficial to agriculture.

The Committee asks whether reductions are ot possible "in the costs and profit margins llowed in all stages of manufacture, trading and ransport". The principal difficulty is the difference n efficiency between the large and the small con- ern. Striking contrasts in efficiency were brought o light by the National Expenditure Committee n the War of 1914–18, and the Costings Branch of he Ministry of Food has already accumulated onsiderable evidence of a similar character.

The tendency for decisions of great importance o be reached as a result of compromise between departments, or between the Ministry and a group of traders, is regarded as perhaps inevitable; but the Committee was clearly of opinion that the national interest might suffer. This consideration naturally led to the discussion of the utilization of trade directors of commodities often drawn from the trade with which the Ministry has to negotiate. While the Committee recognized the useful functions of trade directors, recommendations were made that all decisions on policy should be taken by the Minister on the advice of his Civil Servants.

Towards the end of the report, the Select Committee presented to the House a series of paragraphs referring to the need of forethought in dealing with the planning of food policy.

In these paragraphs the Committee suggested that "it must surely be right to be prepared for the possibility that shipping and other difficulties may necessitate wide modifications in existing diet and to devote the fullest scientific study to every possibility of providing the inhabitants in this country with a ration adequate in calories, etc., at a less cost in shipping and external currency than with the present normal form of diet".

The Committee went on to point out that this was not a matter for the Ministry of Food alone, that it involved the problem of nutrition and obviously also the question of what contribution home production can make. The Committee was obviously of opinion that, although this problem had no doubt been given some consideration, this had been of a "somewhat sporadic nature".

The Committee recognized that the scientific adviser to the Ministry of Food maintained contact with the scientific staff of other Ministries, but expressed doubts whether a single individual could possibly cope with the problems or determine how far scientific research was needed for their satisfactory solution. A Committee composed of scientific men and others was needed to enable full use to be made of scientific knowledge.

The new Government has lost little time in meeting this suggestion of the Select Committee. In the War of 1914–18 most useful services were rendered by a Scientific Committee established on the initiative of the Government under the auspices of the Royal Society. This precedent has now been followed and the Lord Privy Seal, as chairman of the Food Policy Committee of the Government, has announced the formation of an Advisory Committee to consider national food requirements and home food production (see NATURE of June 8, p. 887). The President of the Royal Society is to be chairman and the Society is further represented by four distinguished fellows, and by the Secretary to the Committee, three of whom are especially concerned with the physiological approach and two with crop production. There are two other well-known agricultural experts and an agricultural economist. Business has one representative in the vice-chairman, Sir Alan Anderson, while liaison with economics and finance is provided by the inclusion of Mr. Henry Clay, of the Bank of England, and now on Lord Stamp's Co-ordinating Committee.

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* Fourth Report from the Select Committee on National Expendi- ure. Pp. 60. (London: H.M. Stationery Office, 1940.) 1s. net.

The Advisory Committee, consisting of a chairman, vice-chairman, secretary and eight members, is not an unwieldy body, and, provided the Departments supply it with the fullest information and assistance, it should be able to perform most useful functions.

Its reports will presumably be made to the Food Policy Committee of the Government itself, and its task is nothing less than the evolution of a food policy for the nation. There can be no doubts as to the importance of food in war, nor of the urgency of bringing about the fullest co-ordination between the nutritional needs of the country, food production and the many factors affecting import policy, that is, shipping, financial considerations and the exigencies of economic warfare. Many of the policies evolved will need to be continued during the first years of peace, and it is to be hoped that the pressing necessities which are at last leading to the formulation of a war-time food policy will not be considered as unimportant when peace has been firmly re-established.

The Advisory Committee might therefore regard its task as consisting of, first, urgent and immediate problems to ensure the maintenance of the physical vigour and morale of a nation fighting not only for its existence but also to save the world from the dominance of Nazism; and, secondly, to secure that, on a longer range basis, the newer knowledge of nutrition shall be allowed to bring its full influence to bear upon public health. This, as the Final Report of the League of Nations Committee on Nutrition shows, involves the closest relationship between health, agriculture and commercial policy.

From the point of view of the immediate task, it is greatly to be regretted that the Advisory Committee was not set up months ago. The agricultural season is now advanced, and, although in certain directions it is not too late for action affecting this season to be taken, yet far more could have been accomplished had the need for agricultural policy to be determined by the food requirements of the nation been recognized earlier.

A single example will suffice to illustrate this point. United Kingdom agriculture is mainly based upon animal husbandry, and this, in turn, has depended to a very great extent upon imported feeding stuffs. The British Isles has, however, a largely unexploited asset in its grass. The normal processes of haymaking and aftermath involve an enormous waste of valuable food for animals. There is extreme need for pasture improvement and for better conservation of the food values of young grass. The fact that so little has yet been done to secure the fuller utilization of this great asset is not due to any lack of knowledge of practical means for securing both objectives. Sir George Stapledon and others have for years been both preaching and demonstrating methods whereby the yields from pastures could be doubled. So far as conservation is concerned, cheap and practical methods of making first-class silage from young grass in pits or trenches are well known and have been fully demonstrated. Had vigorous action been taken before the summer flush of grass commenced, sufficient silage could have been conserved to have made a most important contribution to the maintenance of dairy herds during the coming winter, thus reducing the need for imported feeding stuffs or, alternatively, increasing the allowance for poultry or pigs. Given immediate and most vigorous action, a good deal of silage might yet be made, but the major opportunity has been lost for this season.

On this, as on other problems, the members of the Advisory Committee will themselves bring both expert and practical knowledge to the service of the country. More important still, they will, through their scientific associations, have access to the vast mass of information which is available on nutrition, public health, and the impact of biological science upon agriculture. The membership includes men of vision and decision, and it may confidently be anticipated that the Cabinet Food Policy Committee will receive sound advice without unnecessary delays. What may be more in question is whether early action will be taken to make effective use of the advice tendered. A great mass of tradition has to be overcome, vested interests may be in opposition; the Food Policy Committee of the Government will need to exercise considerable resolution if maximum benefits are to be derived from this belated but wholly desirable development.

THE GENUS LILIUM

A Supplement to Elwes' Monograph of the Genus Lilium

By A. Grove and A. D. Cotton. Seven parts. (London: Dulau and Co., Ltd., 1935–1940.) £19 13*s*. 9*d*.

DURING 1877–80 appeared a monumental work by H. J. Elwes entitled "A Monograph of the Genus Lilium". In this publication a series of magnificent plates represented all the lilies at that time in cultivation in Great Britain, the figures being drawn from actual living specimens. Elwes recognized that his work was incomplete, as many other species had still to be introduced into European cultivation. It was characteristic of his enthusiasm and energy that immediately on publication of his monograph he began the long and laborious task of collecting material for a supplement. This he pursued for many years, and although length of life was given to him in full measure, it was not sufficient for the completion of his aim. Associated with him in assembling this additional material was Mr. Arthur Grove, who among other pursuits has devoted a long life to the cultivation and study of lilies. The task has been almost too great for Mr. Grove, but he was fortunate in being able to call in as a colleague Mr. A. D. Cotton, keeper of the Herbarium at the Royal Botanic Gardens, Kew. These two authors have now carried to a conclusion the publication of a valuable supplement, which has been produced in the same form as the original monograph.

Botanical and horticultural publications reached a very high standard during the nineteenth century, and especially in the accuracy and artistic merit of the illustrations they contained. In the present century corresponding publications have not surpassed the products of nearly a hundred years ago, and many would say that they have lagged decidedly behind in their quality. Among these publications of the past the monograph of Elwes is one of the outstanding examples, and appreciation of this is shown by a market value which several times exceeds the original published price. The same is true of another publication of Elwes, entitled "The Trees of Great Britain and Ireland", which was issued in collaboration with the late Prof. Augustine Henry. One may say that the supplement now under review shows the same high quality both in text and in illustrations as was characteristic of the century that is past. As it forms a natural corollary to the monograph, I anticipate that it will receive the same appreciation and that its value will continue to be augmented.

There are some genera of plants which always keep the love and devotion of the horticulturist, and among these, of course, are the rose and the lily. Enthusiasm for these does not always remain at the same level, but during the last thirty years there has been a great revival of interest in the genus Lilium. This may have been only fortuitous, but I am inclined to think that the explorations of these years in China, especially those which brought E. H. Wilson his fame, are in some measure responsible for the increased attention now given to these beautiful plants. This view seems to me to be confirmed by the appearance among the species figured of a large number of Chinese species of Lilium, some of which have already made themselves familiar objects in our gardens while others may yet do so. Among these one cannot fail to mention *L. regale*, *L. Henryi*, *L. Sargentiæ*, *L. Davidi*, *L. Willmottiæ*, *L. Duchartrei*, *L. Wardii*, and that is not the complete tale. This interest in the garden cultivation of Lilium has extended quite naturally to publications on the genus, and amidst many recent and valuable books the older ones on the subject are sharing in this appreciation. This is the case not only in Great Britain; the same attention is also shown in the United States and in France. Among all the publications dealing with the genus, Elwes' monograph and the present supplement occupy pride of place. The two combined form a work of which any possessor may well be proud. If one may judge from similar examples in the past and with the knowledge of the real merit of the work, one may safely prophesy that their scientific value will not diminish and that they will continue to be indispensable for all those interested in the genus.

The supplement has been issued in seven parts, and the number of full-page plates is thirty, as compared with forty-eight in the monograph. The foreword by Dame Alice Godman gives an outline of the genesis of the publication and of the difficulties encountered in the search for completeness of the record. Much is due to her for her support and interest from the beginning and for assuming the entire financial responsibility for the publication itself. The plates have been prepared by Miss Lilian Snelling, whose artistic talent combined with accuracy is well known in other fields of botanical illustration. In beauty as well as in their botanical details they are in my opinion superior even to the fine figures in the original monograph. When we come to the text prepared by the long and painstaking efforts of Messrs. Grove and Cotton, there is no question but that the supplement compares much more than favourably with the text of the monograph. The authors have spared no pains to investigate all the literature dealing with their subject. This has involved not merely reference to botanical literature in order to elucidate the taxonomy, history, and often intricate nomenclature of the species concerned, but also to the horticultural periodicals, for many useful hints concerning cultivation are included in their comments. Much of this valuable information would naturally come from Mr. Grove, who has been for so long an enthusiastic and successful grower of many of the species. The illustrations have been prepared exclusively from living specimens, and there is no doubt that the study of the species in the living state has added greatly to the accuracy of the work. The authors have safeguarded their results by borrowing historical specimens and much herbarium material from many centres throughout the world ; these they interpret in the light of living specimens. Their final judgment has been based in great measure on each species in life.

The perusal of the text will not fail to convince any reader of the scrupulous care and intensive research given to the issue of this supplement. It is admirably done. Of course, in these matters there is never full completion. A few species, which have never been in cultivation in Europe and of which little or nothing is known except the mummified remains in herbaria, have had to be omitted. The aim set by Elwes has been adhered to, and the illustrations feature the plants as they appear in our gardens. At the risk of praising it once again, I affirm that this supplement takes its place with the classics of last century and is no ephemeral but a perpetual treasure.

W. WRIGHT SMITH.

THE INSTITUTION OF ELECTRICAL ENGINEERS

The History of the Institution of Electrical Engineers (1871–1931)

By Rollo Appleyard. Pp. 342 + 38 plates. (London: Institution of Electrical Engineers, 1939.) 18*s.* 6*d.*

IN the sixty-odd years of its existence, progress in the electrical industry has been so extraordinarily rapid and the applications of electricity in the service of man so numerous and widespread that the passing of time may serve to dim or obscure the labours of those who have "directed and safeguarded electrical progress". That this may not be so, the Council of the Institution of Electrical Engineers very wisely decided on the preparation of a history of the Institution, and were fortunate in entrusting the work to Commander Appleyard.

Apart from due cognizance being taken of earlier electrical knowledge and the necessity to refer to post advances, it was decided to confine the history mainly to the sixty years from 1871, when the Society of Telegraph Engineers was founded, to 1931—a fitting limit to such a period of achievement, since it marked the centenary of one of the most fundamental and important of discoveries, namely, Michael Faraday's discovery of "the evolution of electricity from magnetism".

It is perhaps not unnatural that the energy and discoveries of many of the early pioneers of electrical science should be directed to the solution of what was then one of the most urgent problems of man—rapid and easy communication. In the period immediately prior to the formation of the Society of Telegraph Engineers, the importance of electrical telegraphy had irresistibly become recognized. By 1871 the nominal capital of telegraph companies registered in England had reached approximately £40 million, and the "need for a corporate organization to collect, to coordinate and to preserve the results of electrical investigations" had become apparent and found expression in the meeting held on May 17, 1871, at No. 2, Westminster Chambers, Victoria Street, S.W., the minute book of which contains the following eight names : W. Whitehouse ; Captain P. H. Colomb, R.N. ; Major R. H. Stotherd, R.E. ; Louis Loeffler ; Captain C. E. Webber, R.E. ; Captain E. D. Malcolm, R.E. ; Robert Sabine ; and Major Frank Bolton.

Rapidity of progress and extension of the spheres of activity and thought, arising in no small measure from developments such as the Gramme generator and the Jablochkoff lamp, brought about, within the short space of nine years, a broadening of the title to "The Society of Telegraph Engineers and of Electricians", which was later modified to "The Society of Telegraph Engineers and Electricians", under which title it became incorporated in 1883. Improvements in machines associated with such names as Siemens, Edison, Brush, Mordey, Hopkinson and Crompton, and the epoch-making discoveries of Swan and Edison in regard to lamps, provided stimulus for the plea for a society of "sound electricians and engineers only", having for its task the shaping of the practice of electrical engineering into "something like an art, having some definite rules and principles". The title was thus altered in 1888 to "The Institution of Electrical Engineers", under which, in 1921, was granted a Royal Charter of Incorporation. Meanwhile, communication had witnessed the introduction of telephony with the development of the telephone by Bell in 1875 and the microphone in 1878 by Hughes, whilst electrical measurement had advanced by the work of Ayrton, Perry and Thompson, to name only a few.

The period from 1888 was one of progress marked by the development of electrical distribution, transmission and the use of electrical energy spurred by improvements in dynamos, A.C. machines and transformers, at the hands of Hopkinson, Crompton, Mordey, Ferranti and others, until by the close of the century electric power had truly become a handmaid of industry. The application of electrical knowledge was finding an ever-widening field. Electric traction had already been introduced, and a paper by Lodge in 1898 on "Improvements in Magnetic Space Telegraphy" and contributions by Evershed, Dolbear, Willoughby-Smith, Marconi and Tesla inaugurated wireless telegraphy. Contemporary development of the steam turbine by Parsons afforded impetus to bulk generation of electric power, and extensive development of the industrial use of power during the War of 1914–18, followed by more encouraging legislation, brought into being its widespread distribution as afforded by our national 'grid' system. Development of the thermionic valve by J. A. Fleming and the addition to it of a third electrode by de Forest played an all-important part in the transition from wireless telegraphy of 1898 to wireless telephony or broadcasting, which came into service in 1922, soon to be followed by the 'phonofilms' or 'talking pictures' and 'television' of modern times.

This pattern of the development of electrical science and engineering, which has been carefully woven by the author from the work of the Institution and "those who gave it lustre", is coloured throughout by his apt interpretation of vital influences and their magnitudes, by his appreciation of the trials and difficulties inseparable from such progress, and by his skilful presentation of excerpts from discussions and proceedings to illustrate the trend of thought and enlightenment as each new contribution was made. Throughout the pages of the history, names and personalities stand forth in their proper perspective, and the historian brings to light many human characteristics which serve to make very real the personalities he portrays. Just prominence is also given to such important factors in the history of the Institution as its close and beneficial association with the Services, its acknowledgment of duty to the public as exemplified by the issue of rules and regulations governing the installation of equipment and by the encouragement of public interest in matters electrical, its early and sustained assistance to the establishment of a working system of electrical units and to the work of standardization, and its unremitting efforts and encouragement on behalf of the education and training of personnel.

That the preparation of this narrative was no mean task is amply demonstrated throughout the book. The author and all those who assisted in the historical researches are to be congratulated on the result of their labour, which occupied a period of three years, for in the fulfilment of the task there is presented a record and appreciation of those who have had the furtherance of the industry and the well-being of their fellowmen at heart; it will serve as a worthy source of inspiration for those who follow.

The volume, which contains a wealth of fine illustrations, is beautifully produced.

A. P. M. FLEMING.

GRAHAM WALLAS: A SCIENTIFIC HUMANIST

Men and Ideas

Essays. By Graham Wallas. Pp. 221. (London: George Allen and Unwin, Ltd., 1940.) 8*s*. 6*d*. net.

THOUGH the interests of the late Graham Wallas were essentially humanistic, there are more reasons than one why the recently published volume of his essays should receive attention in a journal which, while mainly devoted to the physical and biological sciences, takes cognizance of other work which is informed by the scientific spirit. Such work was that of Graham Wallas, who did great service in helping to make social science worthy of its name. He relates how, at the beginning of his maturer studies, he undertook a voyage of exploration among the papers of Francis Place, and how he came out of his years of research a different man. Research was thereafter the keynote of his intellectual life.

Shrewsbury and Oxford had done much for his general equipment, but the real work of Graham Wallas's life was bound up with London, its school system, and its University. Jeremy Bentham, the spiritual father of that University, had adopted as the aim of all his efforts "the application to the social sciences of the methods already invented for the natural sciences", as these methods presented themselves at the end of the eighteenth century. Graham Wallas adopted the same principle, but with the vital difference in practice that he was born within a year of the appearance of Darwin's "Origin of Species", and that as a youthful 'intellectual' he witnessed the lively controversies that ensued. No one who knew Graham Wallas as a man will be surprised to learn that as an undergraduate at Oxford he wrote to the professor of moral philosophy, defending the theory of evolution against an attack made by that functionary in the course of a lecture.

Graham Wallas was nearing his fortieth year when his "Life of Francis Place" appeared. In his fifties he produced his "Human Nature in Politics" and "The Great Society", and in his sixties "The Social Heritage" and "The Art of Thought". These important works bear the impress of his keen interest in the development, during that period, of a more helpful psychology than had hitherto been at the disposal of the cultivators of social science. They bear also the marks of the man of affairs, who had taken leading parts in the work of the old London School Board, the Education Committee of the London County Council, and the Senate of the University of London, who had undertaken lecturing tours in America, and had served on a Royal Commission on the Civil Service.

Besides his major contributions to the thought of his time, Graham Wallas wrote a number of articles and addresses, a selection of which, edited by his daughter, is given in "Men and Ideas". Some of these papers, such as those on Bentham, remain of substantial value in themselves. Others are of permanent interest as contemporary criticism of the movements to which they refer. His criticism of Froebelian pedagogy, for example, written forty years ago, showed the Froebelians that their master lived under the influence of pre-Darwinian science, and taught them to sift the chaff from the wheat in his teaching. It is, therefore, a paper to be reckoned with by the historian of English education, though the criticism does not apply at the present time. The same may be said of the paper on "Oxford and the Nation", written in 1908, and on "English and American Universities", written in 1914.

Graham Wallas devoted himself to research, and gratefully acknowledged his debt to those men of science who pursue their researches in laboratories, and whose example he followed. But he ventured also to give them a timely hint as to the futility of some work which passes as research and is rewarded with academic distinctions. "It may be essential", he said, "that a young astronomer should pass the years between twenty-one and twenty-three in mastering the mathematics of relativity or the quantum theory. Such work would not produce 'a distinct contribution to the knowledge of the subject', because that contribution has already been made by Einstein and Planck. But when Einstein dies, the collection of personal incidents in his life, or misprints in his editions, will be research." Wallas was capable, not only of a hearty laugh, but also of a shrewd thrust.

T. RAYMONT.

LOCATION OF INDUSTRY

The Location of Industry and the Depressed Areas
By Prof. S. R. Dennison. Pp. vii + 216. (London: Oxford University Press, 1939.) 10*s.* net.

MUCH is expected of the publications of the Economics Research Department of the University of Manchester, and if in some respects Prof. S. R. Dennison scarcely maintains that high standard, he has at least given us a work which no serious student of the Special Areas and the problems they present can afford to overlook. His admirable and careful analysis of the work of the Commissioners for the Special Areas, and appreciation of the results achieved and of the limitations inherent in either their work or policy, sets the problem in its true perspective in relation to unemployment and industrial development generally. While he appears to ignore the experimental character of the Special Areas Act on which stress was laid when the legislation was introduced, he recognizes that the Special Areas measures cannot continue indefinitely as they now operate, and that it will soon be necessary either to rescind them and leave the problem as it is or to extend them.

The second part of the book, in which in successive chapters Prof. Dennison discusses the problem of the Special Areas, the apparent drift of industry to the south and the nature and limitations of Government policy, is most valuable and constructive. He rightly points out that in any industrial system which is not entirely static, technical change coupled with occupational immobility must be a cause of some unemployment, more or less short-lived, but he is concerned at the effect of the immobility of unemployed workers coupled with the decreased mobility of labour generally, particularly as the greater freedom of the location of industry from supplies of raw materials involves the risk of periodic shifts at a greater frequency. He appears to consider that policy should therefore be directed towards increasing the mobility of labour, and he is of the opinion that the policy of transference has not been of a character appropriate to the needs of the Special Areas. Prof. Dennison insists that there are limits also to the possibilities of attracting industries to the Special Areas, particularly in the provision of trading estates, and considers that the Commissioners have never had a well-defined aim : attempts to attract industries and the reconditioning of areas to receive them are clearly inconsistent with a policy of transference.

In his analysis of the drift of the industrial population to the south, Prof. Dennison points out that the relative growth of the industrial population in London and the south-east was not due to the relative rate of expansion of the expanding industries, which expanded with almost equal or even greater rapidity elsewhere, but to the fact that in other areas a much greater proportion of the industrial population was employed in declining industries. The problem of the Special Areas emerges from a series of general changes in industrial structure, and the causes being deep-seated, any policy which deals merely with the symptoms of depression in the areas will be only palliative ; if the causes which have created the Depressed Areas are to be removed, the trends of locational change must be reversed. As the only alternative to a long process of attrition, Prof. Dennison somewhat reluctantly advocates a short-period policy of transference and of encouraging new industrial development in non-derelict Depressed Areas. Such a short-period policy may also throw further light on factors to be taken into account in deciding upon the merits of policy designed to deal with the long-period problems.

It is in the lack of constructive criticism and positive suggestion that Prof. Dennison's book falls short of the standard generally set in the publications of the Economics Research Department at Manchester where the work was carried out. This defect is the more conspicuous in the first part of the volume, in which the economic aspects of the location of industry are discussed in detail. Excellent as is much of the analysis, though sometimes one-sided, Prof. Dennison appears to stress the difficulties in the way of control to an extent which paralyses action. It is well, however, that the implications of control should be set forth with such lucidity, and that in appraising the recommendations of the Majority or Minority Reports of the Royal Commission we should keep in mind the difficulty of defining the areas within which control is to be exercised ; the necessity of basing a policy of control on fairly definite criteria ; the major problem of deciding between diversity and specialization of industries ; or the relation between control and long-term planning and their application not to industry in the abstract but to individual firms. We may equally be grateful for the warning against a too facile assumption that policy will necessarily be distinguished by thought for larger issues and long-period aims, undisturbed by irrational or vested interests.

Prof. Dennison's obvious dislike of control, though he clearly distrusts *laissez-faire*, may possibly be attributed in part to the fact that, by limiting himself to the economic side, he leaves out of account those other large aspects such as town and country planning and regional development with which location of industry is interlocked, and in which such factors as strategic considerations, the preservation of amenities and the like are making action imperative if irreparable damage is not to be done. With miscellaneous exceptions, expert opinion is moving solidly in favour of control of the location of industry, differing only in regard to the means by which control is to be exercised and its extent. So, too, while the report of the Royal Commission and the P.E.P. Report stress the need for the collection and co-ordination of information on the location of industry and on natural resources, Prof. Dennison makes the somewhat naïve suggestion that information already available affords adequate guidance for the location of industry in general.

Here and elsewhere, Prof. Dennison is open to criticism on the grounds of a disappointingly narrow approach. Nevertheless, his discussion of theories of industrial location, particularly of Weber and his school, and analysis of the various factors in location such as transport, labour, taxation, and relation to markets, form an admirable background to the more important part of the book. He makes free use of evidence presented before the Royal Commission, and however disappointing the absence of more positive conclusions may be, the book is one which makes a contribution to the accurate knowledge and diagnosis which Prof. Dennison rightly insists must form the basis of any successful policy. R. BRIGHTMAN.

THE EIGHTH AMERICAN SCIENTIFIC CONGRESS

BY DR. AUSTIN H. CLARK

THE Eighth American Scientific Congress was held in Washington, D.C., during May 10–18, 1940. This Congress was convened by the Government of the United States with two purposes in view. The first was to advance scientific thought and achievement by enabling the scientific men and women of the twenty-one American Republics to meet each other, to exchange ideas, and to form lasting friendships. The second was to assist in the celebration of the fiftieth anniversary of the Pan American Union.

Though primarily scientific, the Congress aimed at integrating science in the Americas with the social and political life of the people, for science can no longer be considered as separate and distinct from other forms of human activity. In our modern civilization science in one form or another enters into every element of our social structure. This is particularly true in the Americas, where the origin and development of science have been democratic to an extent known nowhere else. In the Americas science knows no social classes. All groups have contributed to its advancement. There it has arisen from the people as a whole; it has been, and is being, supported by the people as a whole; and its broad aim is the betterment of the condition of the people as a whole.

Man as he used to be, as he is to-day, and as he is to be in the future; his social organization, welfare, and activities of every kind, and especially man in his relation to America and other Americans —this was the broad subject that occupied the attention of the Eighth American Scientific Congress.

This attitude must not be mistaken for one of isolationism. For the American Republics are all keenly alive to their close affinities, individually and collectively, with the nations of the Old World. This was emphasized at the formal opening of the Congress on the evening of May 10 in a stirring and memorable address by President Franklin D. Roosevelt in which he said:

> "All of the men and women of this Pan American Scientific Congress have come here to-night with heavy hearts. During the past few years we have seen event follow event, each and every one of them a shock to our hopes for the peaceful development of modern civilization. This very day three more independent nations have been cruelly invaded by force of arms.
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> "In some human affairs the mind of man grows accustomed to unusual actions if they are oft repeated. That is not so in the world happenings of to-day—and I am proud that it is not so. I am glad that we are shocked and angered by the tragic news from Belgium and the Netherlands and Luxembourg.
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> "The overwhelmingly greater part of the population of the world abhors conquest and war and bloodshed—prays that the hand of neighbour shall not be lifted against neighbour. The whole world has seen attack follow threat on so many occasions and in so many places during these later years. We have come, therefore, to the reluctant conclusion that a continuance of these processes of arms presents a definite challenge to the continuation of the type of civilization to which all of us in the three Americas have been accustomed."

In his address, President Roosevelt acknowledged with appreciation the great achievements of science in the extension and development of modern civilization. He said that the objectives toward which science is striving are closer and more peaceful relations between all nations through the spirit of co-operation and the interchange of knowledge. He deprecated the idea that science is responsible for the present "attacks on civilization which are in progress elsewhere", remarking that, "The great achievements of science and even of art can be used to destroy as well as to create; they are only instruments by which men try to do the things they most want to do."

The comprehensive scope of the Congress and the interdigitation of science, as commonly understood, with other forms of human activity are well brought out by the titles of the sections into which the proceedings were divided. These were: I. Anthropological Sciences (Herbert J. Spinden, chairman; Alfred V. Kidder, vice-chairman; Julian H. Steward, secretary). II. Biological Sciences (Edwin G. Conklin, chairman; Henry A. Gleason, vice-chairman; James A. G. Rehn, secretary). III. Geological Sciences (T. Wayland Vaughan, chairman; Wendell P. Woodring, secretary). IV. Agriculture and Conservation (Hugh H. Bennett, chairman; Ernest G. Holt, secretary; J. L. Colom, assistant secretary). V. Public Health and Medicine (Thomas Parran, chairman; Hugh S. Cumming, honorary chairman; Lewis H. Weed, vice-chairman; A. M. Stimson, secretary; A. A. Moll, assistant secretary). VI. Physical and Chemical Sciences (Lyman J. Briggs, chairman; Eugene C. Crittenden, secretary). VII. Statistics (Stuart A. Rice, chairman; Raymond Pearl, vice-chairman; Holbert L. Dunn, secretary; Elizabeth Phelps, executive assistant). VIII. History and Geography (C. H. Haring, chairman ; Preston James, vice-chairman ; Robert C. Smith, secretary ; Frank Vane, assistant secretary). IX. International Law, Public Law and Jurisprudence (James Brown Scott, chairman ; Herbert F. Goodrich, vice-chairman ; George A. Finch, secretary ; William Sanders, assistant secretary). X. Economics and Sociology (Harold G. Moulton, chairman ; Benjamin Colby, secretary). XI. Education (Nicholas Murray Butler, chairman ; I. L. Kandel, vice-chairman ; Richard Pattee, secretary ; Harold Benjamin and George I. Sánchez, rapporteurs).

Of most immediate interest to everyone are the sciences grouped under public health and medicine. These in recent years have attracted much attention throughout the Americas. In this section 119 papers were presented. Most of them were of broad general interest from the point of view of public health, though some gave details of the latest work on important and widespread ailments, or on obscure or little-known tropical diseases.

The accumulation of adequate statistical information regarding the population is recognized throughout the Americas as a matter of vital importance. In the section on statistics there were 71 papers, covering nearly all phases of the subject. These were read by statistical experts from all the twenty-one American Republics. An examination of these contributions shows how closely the conditions among the people are now being checked throughout the western hemisphere.

There were many papers on sociology and economics, these subjects being treated both from the point of view of national units and from the point of view of a closer unification of the American Republics.

A closer unification of the American Republics envisions a greater uniformity in legal systems and in legal procedure than exists at present. There were 78 papers dealing with various aspects of international law, public law and jurisprudence. Many eminent jurists took part in the discussion, including the Ministers to the United States from El Salvador and Honduras, the Mexican Under-Secretary for Foreign Affairs, and three members of the faculty of law in the University of San Marcos at Lima, Peru, the oldest university in the Americas, founded in 1551.

There were 61 contributions in the section on education, and 64 in the section on history and geography.

Among the 42 papers in the section of agriculture and conservation, there were several of more than usual interest. Among these were the opening address by the Hon. Henry A. Wallace, Secretary of Agriculture, on "The Vital Role of Agriculture in Inter-American Relations", and another by the Hon. Gifford Pinchot, former Governor of Pennsylvania, on "Conservation as the Foundation of Permanent Peace". The papers as a whole covered a wide range of subjects. Soil erosion, the conservation of agricultural and forest resources, improved agricultural practices, and range problems in both South and North America received special attention.

In the section on geological sciences there were 57 papers dealing with all phases of the subject, though especially with the mineral resources.

The programme of the section of physical and chemical sciences included 62 papers, of which the most outstanding was a contribution by Prof. Albert Einstein, of the Institute for Advanced Study, Princeton University, entitled "Considerations concerning the Fundaments of Theoretical Physics" [see p. 920 of this issue].

There were 79 contributions in the section of biological sciences. Many of these were on various aspects of the extraordinarily rich fauna and flora of tropical America, though there were also many on genetics, evolution, distribution, and other topics.

The scientific programme was supplemented by an elaborate social programme which included, in addition to receptions, teas, garden-parties, and other entertainments, a visit to the famous Luray caverns of Virginia, and an inspection of the restoration of Colonial Williamsburg, Virginia, over which the "Grand Union", the predecessor of the present Union Jack, still flies.

On May 20 the delegates to the Congress were the guests of the American Philosophical Society at Philadelphia, the oldest scientific society in the United States, founded by Benjamin Franklin, and May 21 was set apart as Eighth American Scientific Congress Day at the New York World's Fair, the delegates from the Latin American Republics being the guests of the Fair throughout the day.

In the preparation and carrying out of this extensive social and scientific programme many individuals participated. Mr. Cordell Hull, Secretary of State, was honorary chairman of the Advisory Committee, of which the other cabinet officers were honorary vice-chairmen. On the organizing and advisory committees were practically all the outstanding men of science in the United States.

Those chiefly responsible for the success of the Congress were the Hon. Sumner Welles, Under-Secretary of State, president of the Congress and chairman of the Organizing Committee ; Dr. Warren Kelchner, chief of the Division of International Conferences, Department of State, executive vice-president of the Congress and vice-chairman of the Organizing Committee ; Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, secretary general of the Congress and secretary of the Organizing Committee; and Dr. Frank B. Jewett, president of the National Academy of Sciences, chairman of the Advisory Committee.

The Congress was adjourned with the same note of uneasiness and apprehension with which it had been opened by President Roosevelt. In his farewell address, Mr. Sumner Welles said:

> "You scientists have been free to seek the truth for the sake of that truth. You have been free to use your great powers without hindrance. You have been free to publish the results of your quiet study in your laboratories, or your often hazardous observations, sometimes at the far ends of the earth, without fear that because these results might differ from accepted concepts, you, and even your families, would be subjected to the control and the oppression of the State.
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> "The suppression in some parts of the world to-day of the right of free inquiry, and the endeavour to control the thoughts of men, is therefore of intimate concern, not only to all scientists but likewise to all persons who believe that science has within its grasp the capacity to remedy in great part the ills of our present civilization. We cannot but speculate whether, in those parts of the world where free inquiry is no longer possible, there will not be, at least in so far as the things of the mind and the spirit are concerned, a return to the Dark Ages. What hope is there for future generations in countries where the State by fiat has declared that all persons must believe glaring distortions of the truth; where evil is declared to be good; where falsehood is paraded as the truth; and where aggression, pure and simple, is represented as self-defence? . . .
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> "I believe—as firmly as I believe that the sun will rise once more to-morrow—that the present menace to civilization will pass, and that the day will come when the now destructive forces of evil which men themselves have created will be vanquished. I believe that mankind will again be afforded opportunity to lay the foundations of a better world—a world in which freedom from fear will be established for all mankind and the right of every person to worship God, to think, to speak, to know the truth and to search for the truth will be made sure."

CONSIDERATIONS CONCERNING THE FUNDAMENTS OF THEORETICAL PHYSICS*

BY PROF. A. EINSTEIN, FOR.MEM.R.S.,
INSTITUTE OF ADVANCED STUDY, PRINCETON UNIVERSITY

WHAT we call physics comprises that group of natural sciences which base their concepts on measurements; and the concepts and propositions of which lend themselves to mathematical formulation. Its realm is accordingly defined as that part of the sum total of our knowledge which is capable of being expressed in mathematical terms. With the progress of science, the realm of physics has so expanded that it seems to be limited only by the limitations of the method itself. The larger part of physical research is devoted to the development of the various branches of physics, in each of which the object is the theoretical understanding of more or less restricted fields of experience, and in each of which the laws and concepts remain as closely as possible related to experience. It is this department of science with its ever-growing specialization, which has revolutionized practical life in the last centuries.

On the other hand, from the very beginning there has always been present the attempt to find a unifying theoretical basis for all these single sciences, consisting of a minimum of concepts and fundamental relationships, from which all the concepts and relationships of the single disciplines might be derived by logical process. This is what we mean by the search for a foundation of the whole of physics.

It is clear that the word foundation in this connexion does not mean something analogous in all respects to the foundations of a building. Logically considered, of course, the various single laws of physics rest upon this foundation. But whereas a building may be seriously damaged by a heavy storm or spring flood, and yet its foundations remain intact, in science the logical foundation is always in greater peril from new experiences or new knowledge than are the branch disciplines with their closer experimental contacts.

The first attempt to lay a uniform theoretical foundation in physics was the work of Newton. In his system everything is reduced to the following concepts:

(1) Mass points with invariable mass;
(2) action at a distance between any pair of mass points;
(3) law of motion for the mass point.

There was not, strictly speaking, any all-embracing foundation, because an explicit law was formulated only for the actions-at-a-distance of gravitation; while for other actions-at-a-distance nothing was established *a priori* except the law of equality of

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* An address, slightly abridged, delivered at the Eighth American Scientific Congress at Washington on May 15.

actio and *reactio*. Moreover, Newton himself fully realized that time and space were essential elements as physically effective factors of his system, if only by implication.

This Newtonian basis proved eminently fruitful and was regarded as final up to the end of the nineteenth century. It not only gave results for the movements of the heavenly bodies down to the most minute details, but also furnished a theory of the mechanics of discrete and continuous masses, a simple explanation of the principle of the conservation of energy, and a complete and brilliant theory of heat. The explanation of the facts of electrodynamics within the Newtonian system was more forced; least convincing of all, from the very beginning, was the theory of light.

It is not surprising that Newton would not listen to a wave theory of light; for such a theory was most unsuited to his theoretical foundation. The assumption that space was filled with a medium consisting of material points that propagated light waves without exhibiting any other mechanical properties must have seemed to him quite artificial. The strongest empirical arguments for the wave nature of light, fixed speeds of propagation, interference, diffraction, polarization, were either unknown or else not known in any well-ordered synthesis. He was justified in sticking to his corpuscular theory of light. During the nineteenth century the dispute was settled in favour of the wave theory. Yet no serious doubt of the mechanical foundation of physics arose, in the first place because nobody knew where to find a foundation of another sort. Only slowly, under the irresistible pressure of facts, there developed a new foundation of field-physics.

From Newton's time on, the theory of action-at-a-distance was constantly found artificial. Efforts were not lacking to explain gravitation by a kinetic theory, that is, on the basis of collision forces of hypothetical mass particles. But the attempts were superficial and bore no fruit. The strange part played by space (or the inertial system) within the mechanical foundation was also clearly recognized, and criticized with especial clarity by Ernst Mach.

The great change was brought about by Faraday, Maxwell and Hertz—as a matter of fact half-unconsciously and against their will. All three of them, throughout their lives, considered themselves adherents of the mechanical theory. Hertz had found the simplest form for the equations of the electromagnetic field, and declared that any theory leading to these equations was Maxwellian theory. Yet towards the end of his short life he wrote a paper in which he presented as the foundation of physics a mechanical theory freed from the force-concept.

For us, who took in Faraday's ideas so to speak with our mother's milk, it is hard to appreciate their greatness and audacity. Faraday must have grasped with unerring instinct the artificial nature of all attempts to refer electromagnetic phenomena to actions-at-a-distance between electric particles reacting on each other. All these electric particles together seemed to create in the surrounding space spatial states, to-day called fields, which he conceived as states of mechanical stress in a space-filling medium, similar to the states of stress in an elastically distended body. For at that time this was the only way one could conceive of states that were apparently continuously distributed in space. The peculiar type of mechanical interpretation of these fields remained in the background —a sort of placation of the scientific conscience in view of the mechanical tradition of Faraday's time.

With the help of these new field concepts, Faraday succeeded in forming a qualitative concept of the whole complex of electromagnetic effects discovered by him and his predecessors. The precise formulation of the time-space laws of those fields was the work of Maxwell. Imagine his feelings when the differential equations he had formulated proved to him that electromagnetic fields spread in the form of polarized waves and with the speed of light! At that thrilling moment he surely never guessed that the nature of light, apparently so completely solved, would continue to baffle succeeding generations. Meantime, it took physicists some decades to grasp the full significance of Maxwell's discovery, so bold was the leap that his genius forced upon the conceptions of his fellow-workers. Only after Hertz had demonstrated experimentally the existence of Maxwell's electromagnetic waves did resistance to the new theory break down.

But if the electromagnetic field could exist as a wave independent of the material source, then the electrostatic interaction could no longer be explained as action-at-a-distance; and what was true for electrical action could not be denied for gravitation. Everywhere Newton's actions-at-a-distance gave way to fields spreading with finite velocity.

Of Newton's foundation there now remained only the material mass points subject to the law of motion. But J. J. Thomson pointed out that an electrically charged body in motion must, according to Maxwell's theory, possess a magnetic field the energy of which acted precisely as does an increase of kinetic energy to the body. If, then, a part of kinetic energy consists of field energy, might that not then be true of the whole of the kinetic energy? Perhaps the basic property of matter, its inertia, could be explained within the field theory? The question led to the problem of an interpretation of matter in terms of field theory, the solution of which would furnish an explanation of the atomic structure of matter. It was soon realized that Maxwell's theory could not accomplish such a programme. Since then many men of science have zealously sought to complete the field theory by some generalization that should comprise a theory of matter; but so far such efforts have not been crowned with success.

For several decades most physicists clung to the conviction that a mechanical substructure would be found for Maxwell's theory. But the unsatisfactory results of their efforts led to gradual acceptance of the new field concepts as irreducible fundamentals—in other words, physicists resigned themselves to giving up the idea of a mechanical foundation.

Thus physicists held to a field-theory programme. But it could not be called a foundation, since nobody could tell whether a consistent field theory could ever explain on one hand gravitation, on the other hand the elementary components of matter. In this state of affairs it was necessary to think of material particles as mass points subject to Newton's laws of motion. This was the procedure of Lorentz in creating his electron theory and the theory of the electromagnetic phenomena of moving bodies.

Such was the point at which fundamental conceptions had arrived at the turn of the century. Immense progress was made in the theoretical penetration and understanding of whole groups of new phenomena; but the establishment of a unified foundation for physics seemed remote indeed; and this state of things has even been aggravated by subsequent developments.

The development during the present century is characterized by two theoretical systems essentially independent of each other: the theory of relativity and the quantum theory. The two systems do not directly contradict each other; but they seem little adapted to fusion into one unified theory.

The theory of relativity arose out of efforts to improve, with reference to logical economy, the foundation of physics as it existed at the turn of the century. The so-called special or restricted relativity theory is based on the fact that Maxwell's equations (and thus the law of propagation of light in empty space) are converted into equations of the same form, when they undergo Lorentz transformation. This formal property of the Maxwell equations is supplemented by our fairly secure empirical knowledge that the laws of physics are the same with respect to all inertial systems. This leads to the result that the Lorentz transformation—applied to space and time co-ordinates—must govern the transition from one inertial system to any other. The content of the restricted relativity theory can accordingly be summarized in one sentence: all natural laws must be so conditioned that they are co-variant with respect to Lorentz transformations. From this it follows that the simultaneity of two distant events is not an invariant concept and that the dimensions of rigid bodies and the speed of clocks depend upon their state of motion.

A further consequence was a modification of Newton's law of motion in cases where the speed of a given body was not small compared with the speed of light. There followed also the principle of the equivalence of mass and energy, with the laws of conservation of mass and energy becoming one and the same. Once it was shown that simultaneity was relative and depended on the frame of reference, every possibility of retaining actions-at-a-distance within the foundation of physics disappeared, since that concept presupposed the absolute character of simultaneity (it must be possible to state the location of the two interacting mass points "at the same time").

The general theory of relativity owes its origin to the attempt to explain a fact known since Galileo's and Newton's time but hitherto eluding all theoretical interpretation: the inertia and the weight of a body, in themselves two entirely distinct things, are measured by one and the same constant, the mass. From this correspondence follows that it is impossible to discover by experiment whether a given system of co-ordinates is accelerated, or whether its motion is straight and uniform, and the observed effects are due to a gravitational field (this is the equivalence principle of the general relativity theory). It shatters the concepts of the inertial system, as soon as gravitation enters in. It may be remarked here that the inertial system is a weak point of the Galilean-Newtonian mechanics. For there is presupposed a mysterious property of physical space, conditioning the kind of co-ordination systems for which the law of inertia and the Newtonian law of motion hold good.

These difficulties can be avoided by the following postulate: natural laws are to be formulated in such a way that their form is identical for co-ordinate systems of any kind of states of motion. To accomplish this is the task of the general theory of relativity. On the other hand, we deduce from the restricted theory the existence of a Riemannian metric within the time-space continuum, which, according to the equivalence principle, describes both the gravitational field and the metric properties of space. Assuming that the field equations of gravitation are of the second differential order, the field law is clearly determined.

Aside from this result, the theory frees field physics from the disability it suffered from, in common with the Newtonian mechanics, of ascribing to space those independent physical properties which heretofore had been concealed by the use of an inertial system. But it cannot be claimed that those parts of the general relativity theory which can to-day be regarded as final have furnished physics with a complete and satisfactory foundation. In the first place, the total field appears in it to be composed of two logically unconnected parts, the gravitational and the electromagnetic. In the second place, this theory, like the earlier field theories, has not yet supplied an explanation of the atomistic structure of matter. This failure has probably some connexion with the fact that so far it has contributed nothing to the understanding of quantum phenomena.

In 1900, in the course of a purely theoretical investigation, Max Planck made a remarkable discovery: the law of radiation of bodies as a function of temperature could not be derived solely from the laws of Maxwellian electrodynamics. To arrive at results consistent with the relevant experiments, radiation of a given frequency had to be treated as though it consisted of energy atoms of the individual energy $h\nu$, where h is Planck's universal constant. During the years following it was shown that light was everywhere produced and absorbed in such energy quanta. In particular, Niels Bohr was able largely to understand the structure of the atom, on the assumption that atoms can have only discrete energy values, and that the discontinuous transitions between them are connected with the emission or absorption of such an energy quantum. This threw some light on the fact that in their gaseous state elements and their compounds radiate and absorb only light of certain sharply defined frequencies. All this was quite inexplicable within the frame of the theories hitherto existing. It was clear that, at least in the field of atomistic phenomena, the character of everything that happens is determined by discrete states and by apparently discontinuous transitions between them, Planck's constant h having a decisive role.

The next step was taken by de Broglie. He asked himself how the discrete states could be understood by the aid of the current concepts, and hit on a parallel with stationary waves, as for example in the case of the fundamental frequencies of organ pipes and strings in acoustics. True, wave actions of the kind here required were unknown; but they could be constructed, and their mathematical laws formulated, employing Planck's constant h. De Broglie conceived an electron revolving about the atomic nucleus as being connected with such a hypothetical wave train, and made intelligible to some extent the discrete character of Bohr's 'permitted' paths by the stationary character of the corresponding waves.

Now in mechanics the motion of material points is determined by the forces or fields of force acting upon them. Hence it was to be expected that those fields of force would also influence de Broglie's wave fields in an analogous way. Erwin Schrödinger showed how this influence was to be taken into account, re-interpreting by an ingenious method certain formulations of classical mechanics. He even succeeded in expanding the wave mechanical theory to a point where, without the introduction of any additional hypotheses, it became applicable to any mechanical system consisting of an arbitrary number of mass points, that is to say, possessing an arbitrary number of degrees of freedom. This was possible because a mechanical system consisting of n mass points is mathematically equivalent, to a considerable degree, to one single mass point moving in a space of $3n$ dimensions.

On the basis of this theory there was obtained a surprisingly good representation of an immense variety of facts which otherwise appeared entirely incomprehensible. But on one point, curiously enough, there was failure: it proved impossible to associate with these Schrödinger waves definite motions of the mass points—and that, after all, had been the original purpose of the whole construction.

The difficulty appeared insurmountable, until it was overcome by Born in a way as simple as it was unexpected. The de Broglie – Schrödinger wave fields were not to be interpreted as a mathematical description of how an event actually takes place in time and space, though, of course, they have reference to such an event. Rather they are a mathematical description of what we can actually know about the system. They serve only to make statistical statements and predictions of the results of all measurements which we can carry out upon the system.

Let me illustrate these general features of quantum mechanics by means of a simple example: we shall consider a mass point kept inside a restricted region G by forces of finite strength. If the kinetic energy of the mass point is below a certain limit, then the mass point, according to classical mechanics, can never leave the region G. But according to quantum mechanics, the mass point, after a period not immediately predictable, is able to leave the region G, in an unpredictable direction, and escape into surrounding space. This case, according to Gamow, is a simplified model of radioactive disintegration.

The quantum theoretical treatment of this case is as follows: at the time t_0 we have a Schrödinger wave system entirely inside G. But from the time

t_0 onwards, the waves leave the interior of G in all directions, in such a way that the amplitude of the outgoing wave is small compared to the initial amplitude of the wave system inside G. The farther these outside waves spread, the more the amplitude of the waves inside G diminishes, and correspondingly the intensity of the later waves issuing from G. Only after infinite time has passed is the wave supply inside G exhausted, while the outside wave has spread over an ever-increasing space.

But what has this wave process to do with the first object of our interest, the particle originally enclosed in G? To answer this question, we must imagine some arrangement which will permit us to carry out measurements on the particle. For example, let us imagine somewhere in the surrounding space a screen so made that the particle sticks to it on coming into contact with it. Then from the intensity of the waves hitting the screen at some point, we draw conclusions as to the probability of the particle hitting the screen there at that time. As soon as the particle has hit any particular point of the screen, the whole wave field loses all its physical meaning; its only purpose was to make probability predictions as to the place and time of the particle hitting the screen (or, for example, its momentum at the time when it hits the screen).

All other cases are analogous. The aim of the theory is to determine the probability of the results of measurement upon a system at a given time. On the other hand, it makes no attempt to give a mathematical representation of what is actually present or goes on in space and time. On this point the quantum theory of to-day differs fundamentally from all previous theories of physics, mechanistic as well as field theories. Instead of a model description of actual space-time events, it gives the probability distributions for possible measurements as functions of time.

The new theoretical conception owes its origin not to any flight of fancy but to the compelling force of the facts of experience. All attempts to represent the particle and wave features displayed in the phenomena of light and matter, by direct recourse to a space-time model, have so far ended in failure; and Heisenberg has convincingly shown, from an empirical point of view, that any decision as to a rigorously deterministic structure of Nature is definitely ruled out, because of the atomistic structure of our experimental apparatus. Thus it is probably out of the question that any future knowledge can compel physics again to relinquish our present statistical theoretical foundation in favour of a deterministic one which would deal directly with physical reality. Logically, the problem seems to offer two possibilities, between which we are in principle given a choice. In the end, the choice will be made according to which kind of description yields the formulation of the simplest foundation, logically speaking. At the present, we are quite without any deterministic theory directly describing the events themselves and in consonance with the facts.

For the time being, we have to admit that we do not possess any general theoretical basis for physics which can be regarded as its logical foundation. The field theory, so far, has failed in the molecular sphere. It is agreed on all sides that the only principle which could serve as the basis of quantum theory would be one that constituted a translation of the field theory into the scheme of quantum statistics. Whether this will actually come about in a satisfactory manner, nobody can venture to say.

Some physicists, among them myself, cannot believe that we must abandon, actually and for ever, the idea of direct representation of physical reality in space and time; or that we must accept the view that events in Nature are analogous to a game of chance. It is open to every man to choose the direction of his striving; and also every man may draw comfort from Lessing's fine saying, that the search for truth is more precious than its possession.

OBITUARIES

Prof. Hugo Merton

THE Nazi régime has claimed as victim another scientific worker in the person of Prof. Hugo Merton, zoologist and traveller. In 1935 he was compelled to withdraw from his posts of deputy director of the Senckenberg Naturalist Society's Museum, assistant in the Zoological Institute of the University of Heidelberg and professor without chair of zoology, and in 1937, at the invitation of Prof. F. A. E. Crew, he went to the University of Edinburgh to work at the Institute of Animal Genetics. In the autumn of 1938 he set out for Heidelberg, but on reaching Germany was arrested and sent to the concentration camp at Dachau, and when he was released and returned to Edinburgh in the following year his health was broken. He died on March 23, 1940, sixty years of age.

Merton was educated at the Universities of Bonn, Berlin and Heidelberg, and specialized in the biological sciences. His many researches fall into groups, to each of which he made contributions of value: the histology of the sense-organs, nervous system and musculature of various molluscs; the anatomy and histology of the aberrant Temnocephala linking Turbellaria and Trematoda; studies on spermatozoa and experiments on ciliary movement and Protozoa, including his work on the geotaxis of Paramecium. In Edinburgh he concentrated upon physiological problems relating to sex.

But the most striking of all Merton's achievements was his expedition to the south-east Moluccas, undertaken on behalf of the Senckenbergischen Naturforschenden Gesellschaft. From October 1907 until August 1908 he explored the Aru and Kei Islands, bringing home vast zoological collections, the description of which by experts occupies two large volumes published at Frankfurt-am-Main in 1911 and 1913. The catholicity of his own interests is shown by his 200-page introductory account of the geography and ethnology of the islands.

Dr. Merton is survived by his widow, to whom the late Prof. Max Weber paid the compliment of dedicating one of his new species of fish from the Moluccas, on the ground that throughout she took an active part in the labours of her husband.

JAMES RITCHIE.

Prof. Pierre Marie

PROF. PIERRE MARIE, the celebrated French neurologist, whose death took place recently, was born on September 9, 1853, in Paris, where he received his medical education and qualified in 1883 with a thesis on the incomplete forms of Graves' disease, which afterwards became a classic. After serving as Charcot's chief assistant at La Salpêtrière he was elected physician in 1885 to the Bicêtre Infirmary, where he set up a rich collection of interesting records of cases, specimens and photographs of various diseases of the nervous system and attracted a large number of practitioners and students, many of whom have become distinguished neurologists. In 1907 he was elected professor of morbid anatomy in the Paris faculty of medicine in succession to Victor Cornil.

Prof. Marie made numerous valuable contributions to neurology. In addition to adding to our knowledge of well-recognized diseases such as rabies, disseminated sclerosis and epilepsy, he was the first to describe acromegaly (1886). In 1892 he brought out a book on diseases of the spinal cord which, like his articles on acromegaly, was published in English by the New Sydenham Society. In 1906 he caused a considerable sensation in the medical world by the publication of three articles on aphasia in the *Semaine Médicale*, in which he declared that the third left frontal convolution of the brain played no special part in the function of language, as had been maintained by Broca. During the War of 1914–18 he did valuable work in conjunction with his *interne*, Mme. Athanasio Benisty, on the symptoms and treatment of injuries of the nerves, which were published by her in the French "Horizon" series and in English form in the "Medical Military Manuals". In 1926 and 1928 he did good service to neurologists and others by publishing in two volumes, entitled "Travaux et Mémoires", the most important of his articles which had appeared in various periodicals and society reports.

J. D. ROLLESTON.

Prof. W. Blackadder

PROF. W. BLACKADDER, who died on May 14, graduated B.Sc. in engineering in the University of Edinburgh in 1897 and was awarded the Vans Dunlop Scholarship. After graduating he gained a wide experience in general engineering practice with the Caledonian Railway, Aberdeen Harbour Commissioners and the Clyde Navigation Trust. In 1907 he was appointed lecturer in civil engineering and applied mechanics in the Royal Technical College, Glasgow, under the late Prof. Longbottom, who at one time acted as assistant to the late Karl Pearson.

Prof. Blackadder was specially interested in structural theory and hydraulics and succeeded in developing this interest in students and staff alike. His teaching bore the hallmark of the master and was always abreast of modern developments. In 1924 he was appointed as first occupant of the Jackson chair of engineering in the University of Aberdeen and succeeded in building up a most efficient department. He was deeply interested in the welfare of his students and aimed at giving a sound theoretical training in engineering science in which the teaching of practical engineering formed little part except to illustrate to some small extent the application of that science in practice.

As a result of researches into the losses in turbine pumps and flow of water in looped pipes he was awarded the D.Sc. by his Alma Mater in 1923, while in 1932 he was awarded the Telford Premium by the Institution of Civil Engineers for his paper on "Direct Methods for Construction of Influence Lines for Continuous Girders".

WE regret to announce the following deaths:

Sir James Baillie, O.B.E., formerly vice-chancellor of the University of Leeds, on June 9, aged sixty-seven.

Sir Thomas Hudson Beare, regius professor of engineering in the University of Edinburgh, on June 10, aged eighty.

Mr. Oliver Gatty, research chemist, aged thirty-two, and Mr. A. S. Chessum, research engineer, aged twenty-seven, during an experiment in connexion with air raid precautions, on June 5.

Prof. A. E. H. Love, F.R.S., Sedleian professor of natural philosophy in the University of Oxford, on June 5.

Sir Jocelyn Thorpe, C.B.E., F.R.S., emeritus professor of organic chemistry in the University of London and in the Imperial College of Science and Technology, on June 10, aged sixty-seven.

NEWS AND VIEWS

Prof. T. Slater Price, O.B.E., F.R.S.

THE retirement has been announced at the end of the present academic year of Prof. T. Slater Price from the chair of chemistry at the Heriot-Watt Technical College, Edinburgh. Dr. Slater Price's early work was concerned with the oxidation of iodide by persulphates, with electro-analysis, and with the electrolytic method for the preparation of organic disulphides and diselinides. His interest in the oxyacids of sulphur continued, and he later provided some of the first evidence for the structure of Caro's acid. In 1903 he was appointed head of the Chemistry Department of the Birmingham Municipal Technical College, a position which he held with great success until 1920. There was, however, one interruption to this work at Birmingham; this was caused by his appointment, as Lieut.-Commander, R.N.V.R., to the Naval Experimental Station during 1916–19, where he carried out many valuable investigations on smoke screens, etc., for which he was afterwards given the O.B.E.(Mil.). Returning from this excursion, Dr. Slater Price met the chaos produced by a great influx of demobilized service men to technical classes. His Chemistry Department included pharmacy, so that the number of students to be accommodated was very large. However, order was soon established and the teaching work went on smoothly, though its demands prevented any rapid extension of the researches on complex cobaltammines upon which Slater Price had been engaged for several years.

Nor did Dr. Slater Price take up this work again, for in 1920 he was appointed director of the British Photographic Research Association, where he remained until 1930. The mechanism of light action on photographic materials was very little understood and formed a constant subject of research in his laboratory throughout this period, and by the end of 1930 work on the photoconductivity of silver halides had laid the foundations for much of the modern advance in the theory of the photographic image. The chemistry of the photographic emulsion also was studied, and much work was done on the influence of the chemical environment of the growing crystals of silver halide in a medium of gelatin and water. In spite, however, of the interest of industrial chemistry, the appeal of academic work was very strong, and in 1931 Dr. Slater Price returned to it once more in the post which he has held from that time, giving his energy in great part to the reorganization of his department, one section of which now includes equipment for micro-analysis. He has encouraged research by the members of his staff, one of whom is now studying the properties of chromium-ammines. Dr. Slater Price has also given much service on the councils of various scientific bodies, notably the Institute of Chemistry, the Chemical Society, and the Royal Photographic Society.

James Nevins Hyde (1840–1910)

DR. JAMES NEVINS HYDE, one of the most distinguished American dermatologists, was born at Norwich, Connecticut, on June 21, 1840, the son of a merchant. He received his medical education at the College of Physicians and Surgeons, New York, and qualified in 1869 at the University of Pennsylvania in Philadelphia. From that date until his death he practised in Chicago, where he was the principal pioneer in dermatology. His first appointment was that of lecturer in dermatology at the Rush Medical College from 1873 until 1876, when he was made professor of dermatology in the Northwestern University. Three years later he became professor of dermatology, genito-urinary and venereal diseases at Rush Medical College, and from 1902 until 1910 he held the chair of dermatology at the University of Chicago. He was also attending dermatologist to several hospitals in Chicago. His literary output was considerable. In addition to his principal work, "A Practical Treatise on Diseases of the Skin", which first appeared in 1883 and ran through eight editions, he contributed more than a hundred articles to dermatological literature. Hyde enjoyed an international reputation as shown by his membership of the dermatological societies of France, Italy, Berlin and Vienna. He was twice president of the American Dermatological Association and was secretary for America at the Fifth International Dermatological Association held in Berlin in 1904. He died suddenly at the age of seventy on September 6, 1910.

Dr. Waldemar Kernig

DR. WALDEMAR KERNIG, an eminent Russian physician, who died in 1917, was born on June 16, 1840, at Dorpat, where he received his medical education. He qualified in 1864 with a thesis on the regulation of the temperature in man and immediately afterwards became physician to the Obuchow Hospital at St. Petersburg. Subsequent posts held by him were those of physician to a deaf and dumb school from 1873 until 1890 and lecturer in internal medicine in the medical courses for women in the Empress Marie's institutions. He contributed several articles to periodical medical literature on splenic abscesses, subfebrile conditions of considerable duration, subcutaneous injection of Fowler's solution, etc., but he is best known by his name having been attached to a sign indicating meningitis which he described in two articles (*Berlin klin. Woch.*, 21, 829; 1884; and *Z. klin. Med.*, 64, 19; 1907).

M. V. Lomonosov

A LECTURE on Lomonosov (1711–1765), the first Russian man of science, will be given by Prof. J. D. Bernal at the Ambassadors' Hotel, W.C.1, at 7.30 p.m. on June 28. This fisherman's son from Archangel, his curiosity aroused by the icebergs and aurora borealis of his native province, ran away to school in Moscow at the age of nineteen. He entered the German-staffed Academy of Sciences set up by Peter the Great, being the first Russian to do so, and the first to lecture in his native tongue instead of in Latin.

He propounded theories on the structure of matter, the kinetic theory of gases, and the mechanical theory of heat, a hundred years in advance of their general introduction ; he built a 'thunder-machine' to study electricity ; he wrote about the physical condition of the sun, the atmosphere of Venus, metallurgy, and gravity ; he was the first to point out the possibility of the passage now established as the Great Northern Sea Route ; he published the first Russian grammar and founded the University of Moscow. Because he was only one outstanding figure in an age of absolutism, much of his work perished with him, and his importance as a pioneer has only recently been recognized. Further information concerning the lecture can be obtained from the Secretary, S.C.R., 98 Gower Street, London, W.C.1.

The British Pharmaceutical Conference

THE seventy-sixth annual meeting of the British Pharmaceutical Conference was the briefest in its annals. It was held at the headquarters of the Pharmaceutical Society on the afternoon of June 11, and the proceedings were limited to the address of the chairman, Mr. H. Humphreys Jones. The theme of the address was the role of pharmacists in relation to the food problem. He said that physiology is an integral part of the curriculum of study of the pharmaceutical student. Items in the syllabus are the physiology of the alimentary tract, comprising a knowledge of the control of salivary, gastric, pancreatic and biliary secretion. The chemistry of certain specified food sustances and the properties of the digestive juices and bile are also subjects of the curriculum. The main reason for their inclusion is, he said, the acceptance of the fact that pharmacists must keep pace with medical progress, and a further reason is the necessity for the pharmacist to be alive to the general awakening regarding food values. He must know not only the pharmacopœia —in which standards are laid down for certain organo-therapeutical substances, such as insulin, pituitary and thyroid as well as sera and vaccines— but also the chemistry of meat, eggs and bread and the properties of the digestive juices.

Mr. Humphreys Jones argued that, while in the past the aim of pharmacy has been to provide drugs to cure diseases rather than to prevent them, a wider vista has been opened up which invites the application of the knowledge of food values with a view to the prevention of disease and the maintenance of a general high standard of health at all periods of life. It has long been recognized that rickets, scurvy and many other diseases are due to the absence of certain food constituents ; this emphasizes the desirability of the close study by students of this part of the curriculum. In this connexion he said, "The [Pharmaceutical] Society has already done good work in connexion with vitamins. But why regard vitamins as the only important ingredients in real food ?" Hitherto, he said, the pharmacist has depended almost exclusively upon his own initiative and ingenuity ; as a servant of the State, his main privilege is that he can sell and dispense scheduled poisons and dispense medicines under the National Health Insurance Act. In Mr. Jones's view, there ought to be an avenue through which the pharmacist's knowledge of nutrition would be similarly recognized ; if a person is compelled by the State to pass an examination in a subject of first-class importance, he should be provided with the opportunity of utilizing that knowledge in the public service. In short, the public should be taught to regard the pharmacist as a dietitian.

The Institution of Professional Civil Servants

THE twenty-first annual report of the Council of the Institution of Professional Civil Servants, presented to the annual general meeting on April 25, indicates that in spite of the pre-occupation of Government departments, and especially the defence departments, with more pressing issues than service conditions, the Council has been available to secure a considerable number of increases in salary and other improvements in the conditions of employment. The report gives a review of activities which shows that the Council has fully maintained its vigilance over the interests of members in the difficult conditions of war-time, despite the removal to temporary offices and the heavier responsibilities falling on the honorary officers since the usual method of control by Council and its committees came in abeyance, and that claims or representations have been preferred with a sense of proportion and balance highly creditable to the Institution.

Special attention is given in the report of the Institution to numerous problems arising out of the evacuation of civil servants, of whom to date about 20,000 have been transferred to provincial towns. Concessions have been secured in regard to visits to families, billeting payments, daily travelling expenses and the like, and the formation of committees of the staffs of evacuated departments in the reception towns is being attempted. Numerous details are included in the report of representations on matters affecting the staffs of Government scientific establishments.

Scientific Films in War-Time

THE London Scientific Film Society gave four shows last winter of scientific and documentary films and received encouraging support. A new form of programme was generally appreciated. Several films with a common subject or theme were shown together ; programmes on contrasting or complementary treatments of psychology, civics in Great Britain, and agriculture being presented. All films shown by the Society are approved by the Scientific Films Committee of the Association of Scientific Workers, 30 Bedford Row, London, W.C.1. This body was set up in 1937 to further the interests of the scientific documentary film, to encourage the making and to sponsor the exhibition of such films. The films are broadly of three kinds: interpretative films, which bring out the relations of science to society and which try to smooth out the difficulties arising from developments and changes in science and social life; educational films, aiming simply to instruct; and research films, serving as a scientific instrument in the hands of the research worker. The Scientific Films Committee grades films into classes in this way, and also appraises their scientific value. The Committee's lists can be obtained on application; universities, schools and scientific societies can use them to help in making up programmes of scientific films. The work of appraising films will go on through the summer. In addition, the Committee's advice is available to producers, and recommendations for new films are to be made; certain subjects, such as chemistry, are very inadequately covered. The Committee wants the opinions of teachers and heads of scientific departments on what is needed, and the special requirements of war-time will be borne in mind.

Radiotherapeutic Panel of Physicists

SINCE the gift of a large sum of money to the King Edward's Hospital Fund by Sir Otto Beit in 1928 for the purchase of radium for use in the treatment of cancer, the Fund has taken an ever-increasing practical interest in the work associated with this and other gifts especially reserved for radium. When the National Radium Commission came into being in 1929, working arrangements were soon made between it and the Fund whereby the latter body became responsible for seeing that the radium needs of the London area were satisfied. In the developments of the last few years, the Fund has been assisted by an expert Radium Committee, which is now presided over by Sir Cuthbert Wallace. Recently this Committee has been considering in what way radiological treatment could be improved, and the Fund has approved the formation of a panel of consultant physicists. The chief reason that has led to this step is the realization that radiotherapy should be, can be, and is at some centres carried out on a quantitative basis, and that for this purpose the services of a physicist are necessary. The panel is designed to serve the needs of the many hospitals in which radium and X-ray treatment is carried out, but at which the employment of a physicist is precluded by expense. The groups of physicists constituting this panel are as follow: Dr. H. T. Flint and colleagues, Physics Department, Westminster Hospital, S.W.1; Mr. L. G. Grimmett and colleagues, Physics Department, Radium Beam Therapy Research, Radium Institute, Ridinghouse Street, W.1; Prof. F. L. Hopwood and colleagues, Physics Department, St. Bartholomew's Hospital, E.C.1; Dr. W. V. Mayneord and colleagues, Physics Department, Royal Cancer Hospital, Fulham Road, S.W.3; Prof. S. Russ and colleagues, Physics Department, Middlesex Hospital, W.1.

African Studies in War-time Paris

WHILE the intellectual and scientific activities of Paris, like those of London, suffered dislocation at the outbreak of war, efforts have been and continue to be made to resume them in as full a measure as is compatible with the demands of war on the resources of the city. In a review of what has been accomplished so far, with special reference to the facilities for African studies, Prof. Henri Labouret (*Africa*, 13, 2; 1940) refers to the action of the Government in sanctioning the reopening of the École Nationale de la France d'Outremer (École Coloniale). As an adjunct, the public as well as the students have been readmitted to the facilities for reading and study in the libraries and exhibition galleries of the Musée de l'Homme (Trocadéro) and the Institut d'Ethnologie. The Institut Français d'Anthropologie, the Société des Africanistes and the Société d'Anthropologie have resumed work and are to continue their meetings.

In view of the need for the extension of the co-operation of French and British authorities in Africa to the field of scientific research—a need which should be self-evident—it is interesting to note that M. Labouret is able to record that the Institut Français d'Afrique Noir, although it has lost a number of its most prominent supporters, has survived the crisis. This body was founded in 1938 only, but is already recognized as an important centre of African research. It will continue to publish its substantial *Notes Africaines*, and has taken over the responsibility of issuing the *Bulletin du Comité d'Études Historiques et Scientifiques de l'Afrique Occidentale Française*, founded by Prof. M. Delafosse in 1915. It will appear, however, in a new and enlarged form.

Daytime Lighting of Blacked-out Factories

THE Industrial Health Research Board is at present investigating the effects of complete obscuration of daylight on health and output, and also the problem of securing the best artificial lighting during the hours of daylight. R. Maxted and J. Bertram, who have been associated with this work, have written an interesting account in the *Electrical Times* of June 6 of experiments in factory lighting, reproducing by artificial means the most desirable features of natural lighting. Normal modern practice, based on pre-War experience, dwells on the importance of adequate illumination levels and of limitation of glare. But war-time conditions have greatly accentuated defects which were tolerable under peace conditions of working. In addition, the blacking-out of windows and skylights has usually resulted in conditions such that the psychological effect is of a magnitude creating an entirely new factor. It is unavoidable that operatives are required to work longer hours. It is obviously vital to ensure that any sense of strain is not associated in their minds with factory conditions, which should clearly be designed to conserve both mental and physical reserves. No other factor is more potent psychologically than the lighting installation. Diagrams are given showing the objectionable tunnel effect produced when the natural skylights are blacked out. The absence of distracting dazzle and the avoidance of glare raise and maintain the output of the factories.

War-Time Museum Exhibitions

THE *Museums Journal* of May shows in what way many museums in Great Britain are endeavouring to stimulate interest by supplying information bearing upon warfare or upon the needs which it has created. In the former group is the special war-time exhibition at the National Maritime Museum, described by Sir Geoffrey Callender. Two contrasting sets of medals are shown, one German and one wrongly described as "English", for the only representative mentioned is "the General Service Medal conferred on *British* officers and men" during the Napoleonic wars. Lightship and lifeboat models, models showing the story of the development of the torpedo-boat, and of the evolution of anchors from their simple beginnings as heavy stones, are arranged with larger exhibits such as that illustrating the evolution of naval ordnance, to make a varied show which as a whole illustrates "the age-long character of our sea-experience and the continuity of our maritime prestige". The second type of exhibit has been created in several museums "to show how the various kinds of foods, essential to man's existence, may be provided by vegetables and grown on a small allotment or in a garden". Several illustrations indicate how, by models of garden plots and cropping plans, this good work may be pursued.

Investigation of Atmospheric Pollution

REPRESENTATIVES of local authorities and other bodies co-operating in the investigation of atmospheric pollution met in London on May 28. The Conference, in considering its annual report to the co-operating bodies, unanimously agreed that while contribution to the war effort is the first duty and desire of every organization, the need for vigilant attention to the purity of the atmosphere has by no means decreased since the outbreak of the War. The wasteful burning of fuel, and the detriment which pollution causes to the nation's health were stressed. The Conference therefore urged all local authorities to do whatever lies in their power to maintain the investigation. At the close of the meeting, Prof. W. H. Roberts, associate professor of public health chemistry in the University of Liverpool, was unanimously elected chairman of the Conference.

Electricity Applied to Metallurgy

IN the Menelaus Memorial Lecture delivered to the South Wales Institute of Engineers on March 19, Dr. A. P. M. Fleming chose as his subject "Electricity as applied to Metallurgy". A most important application arises in connexion with methods of testing. Dr. Fleming points out that electricity has proved an invaluable aid to the metallurgist when making fine measurements and researches, as well as for checking the quality of his materials. Using standardized specimens the composition and heat treatment of which are known, comparisons may be made of unknown specimens by magnetic testing. By suitable exploration of the magnetic behaviour of the specimen in an alternating magnetic field, it is possible to relate the phase and quadrature components of the voltage induced in a search coil, and by comparing these with the standardized specimen, definite inferences can be drawn as to the composition of the material without the necessity of destroying the specimen under test.

Magnetic methods have also been developed for fault detection, and have been of increasing importance due to the tendency to cut down material costs and weight, while still maintaining the safety factor, by more rigid inspection and care in production. The presence of a fault or change in magnetic composition can be detected by the distortion these cause in the magnetic field, the distortion being located either by a direction indicator like a magnetic needle or a moving search coil. Another and most valuable method is that developed largely by the Metropolitan-Vickers Electrical Co., Ltd., in which the specimen is magnetized and then subjected to examination under a coating of liquid containing very finely divided magnetic particles. When examining material in the shape of a bar for longitudinal cracks, a heavy current is passed down the bar while it is immersed in a bath of finely divided magnetic particles, suspended in a light oil. These particles form sharply defined lines which indicate the flaws. This method is of growing importance, and is probably the most effective means at present available of checking this form of weakness in metals.

Incorporated Municipal Electrical Association

THE activities of the Incorporated Municipal Electrical Association (I.M.E.A.) are described in the *Electrical Review* of May 10. The Association is taking steps to ensure that stocks of coal held by public utility undertakings in Great Britain shall be built up during the coming months to ensure that by September 30 the undertakings will have not less than ten winter weeks supply on hand. The Council has agreed that a scheme of insurance in respect to war damage to electricity undertakings should be prepared and has referred the matter to the Joint Committee of Electricity Supply Associations. The members of the Association have been recommended by the National Whitley Council to grant a temporary increase of salary to administrative, technical and clerical staffs. The Joint Committee of Electricity Supply Associations has approached the Minister of Home Security with a view to the relaxation of the restrictions upon the use of neon and other outdoor signs during hours of daylight.

The Finance Officer of the London and Home Counties J.E.A. (Mr. A. L. Burnell) recently prepared a memorandum on the transfer of hire-purchase agreements from one authority to another upon the removal of a consumer when he is unable immediately to complete payment. Difficulties are raised by the varying practice among undertakings in such matters as maximum periods, interest-rates, local limitations as to the type of apparatus and absence of hire purchase facilities in some areas, but all of these can be surmounted. Mr. Burnell suggests that all undertakings should be prepared to take over agreements on the original terms.

Cancer Research and Treatment in Australasia

THE Tenth Australian – New Zealand Cancer Conference, held at Wellington in February of last year, was concerned with cancer control, reports on particular forms of treatment (Koch and Baker) and radiological physics. The part being played by the physicist in the use of X-rays and radium is a rapidly growing one; this arises from the growth of quantitative methods in giving doses of radiation to patients. These methods not only allow the specification of the dose actually given, but also they aim at arranging for the optimum distribution of the radiation throughout the tissues. The report from the Commonwealth X-ray and Radium Laboratory shows a wide range of activity at this centre, with a most progressive outlook as to the function of the physicist in collaboration. It is good to learn that the Commonwealth Department of Health has made the services of the physicists-in-charge available to radiotherapeutic institutions for consultation on the various physical problems of X-ray and radium therapy, and advantage is being taken of such facilities, doubtless to the benefit of patients.

American Zeal for Education

SCHOOL and college summaries seem perpetual in the United States. "A Review of Educational Legislation: 1937 and 1938", by Mr. Ward Keesecker (Washington, D.C., 10 cents), has involved, we are told, a study of 1,500 enactments. The main tendencies exhibited are increased support from the State with more control and the establishment of minimum State-aid foundations. Pennsylvania in 1937 paid special attention to local schools, county boards of directors, the merging of schools poorly attended, and transportation routes. In Georgia all teachers now have to be classified according to their training and experience. In Nevada, amendment of the liquor-licence law increased the amount set aside for education. Tennessee added 4½ million dollars to school funds. Two States, Arkansas and Vermont, made teaching on the effects of alcohol compulsory from grades 3 to 8. Montana required all public schools to give instruction in music, art, and elementary agriculture. Several States increased the minimum salaries of teachers and their benefits on retirement, and Kentucky forbade city schools to discriminate against married women as teachers. It is clear that throughout the country great pains have been taken to see that education is better managed and financed.

Smithsonian Institution: Annual Report

THE report of the secretary of the Smithsonian Institution for the year ended June 30, 1939, which has been published, refers to the completion by the Astrophysical Observatory of the enormous task of recomputing the daily solar constant values from all its observing stations since 1923, apart from the final corrections and general discussion, which were expected to be concluded by October 1939. The Division of Radiation and Organisms gave much attention during the year to photosynthesis, factors influencing plant growth and the stimulative action of ultra-violet radiation. Experimental evidence was obtained indicating the formation during photosynthesis of a material which combines with or absorbs carbon dioxide and resembles chlorophyll in character. A quantitative method for the isolation of hormones from plants is being developed, and the effect of radiation on the growth of excised roots and leaves has been investigated.

Numerous scientific field investigations in anthropology have been conducted by the National Museum as well as archæological and ethnological expeditions by the Bureau of American Ethnology, including investigations of Folsom man at the Lindenmeier site in northern Colorado, studies in the northern province of the Navaho Indians, as well as in western South America. In addition to the report of the Executive Committee of the Board of Regents, appendixes include detailed reports of the work of the various divisions, including the National Gallery of Art, the Freer Gallery of Art, the National Collection of Fine Arts and the National Zoological Park, the last-named giving a detailed list of animals in the collection that had not previously been exhibited.

Awards of the Finney-Howell Research Foundation

THE Finney-Howell Research Foundation, Inc., of Baltimore, Maryland, announces that fellowships for research into the cause or causes and the treatment of cancer were renewed for the following: P. C. Aebersold, working at the Radiation Laboratory of the University of California at Berkeley; G. M. Badger, working at the Royal Cancer Hospital (Free) at London, England; Ll. W. Law, working at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine; J. L. Melnick, working at Yale University School of Medicine at New Haven, Conn.; J. F. Menke, working at Stanford University Hospital, at San Francisco, California; J. L. Wood, working in the Division of Chemistry, Harvard University, at Cambridge, Mass.; P. C. Zamecnik, working at Copenhagen. New fellowships have been awarded as follows: J. C. Abels, to work at the Memorial Hospital for Cancer at New York City; M. A. Graubard, to work at Clark University, Worcester, Mass.; J. W. Howard, to work at Thorndike Memorial Laboratory, Boston City Hospital, Boston, Mass.; B. E. Kline, to work at the Department of Physiology, University of Wisconsin, Madison; Margaret N. Lewis, to work at Crocker Radiation Laboratory, University of California, Berkeley; A. Marshak, to work at the Radiation Laboratory, University of California, Berkeley; Dr. G. C. Gey was also awarded a grant of 2,000 dollars to carry on his work on cancer at the Johns Hopkins Medical School. The closing date for applications for awards during 1941 is January 1, 1941.

Bicentenary of the University of Pennsylvania

THE University of Pennsylvania, Philadelphia, celebrates this year the bicentenary of its foundation. During July and August, the laboratories, museums and libraries of the University, the Morris Arboretum and other places of interest will be open to visitors, and the principal celebrations will take place during the week September 15–21. The week will open with addresses by well-known authorities, which are intended not only to serve as tributes to the University of Pennsylvania but also to focus attention upon the contributions which higher education has made and can still make to the betterment of mankind. Among delegates announced from Great Britain are Sir Henry Dale, Sir Thomas Lewis, Sir William Beveridge, Prof. A. J. B. Wace, Sir Robert Robinson and Dr. C. S. Myers. Some forty symposia and conferences have been arranged to follow the general sessions. In connexion with the celebrations, a Bicentennial Fund has been inaugurated, and by the early part of April, more than four million dollars had already been subscribed, of which a half had been contributed by alumni of the University.

Announcements

SIR ARNOLD WILSON, K.C.I.E., C.S.I., C.M.G., M.P., distinguished for his administrative work in India and Persia, chairman of the Industrial Health Research Board during 1926–33, has been reported by the War Office as missing.

SIR FRANK E. SMITH, F.R.S., director of instrument production in the Ministry of Supply has, in addition, been appointed controller of telecommunications equipment with full authority, by the Minister of Aircraft Production.

MR. J. DAVIDSON PRATT has been appointed an additional deputy director-general for chemical research, experiment and development in the Ministry of Supply. Mr. Davidson Pratt has been since 1928 general manager of the Association of British Chemical Manufacturers, who have now agreed to second him for his present appointment.

THE joint committee of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society has awarded the Dr. W. S. Bruce Memorial Prize (1940) to Mr. Brian Roberts, Emmanuel College, Cambridge, for his valuable work in survey, ornithology and general biology in the north and south polar regions.

THE following appointments and promotions in the Colonial Service have recently been made: R. W. Rayner, plant pathologist, Kenya; C. B. Garnett, agricultural officer, Tanganyika Territory, to be marketing officer, Nyasaland; N. Humphrey, agricultural officer, to be senior agricultural officer, Kenya; E. B. Martyn, botanist and plant pathologist, British Guiana, to be plant pathologist, Jamaica; A. J. Wakefield, director of agriculture, Tanganyika Territory, to be inspector general of agriculture in the West Indies; R. H. Tyrwhitt-Drake, director of surveys, Zanzibar, to be director of surveys, Kenya; G. B. Simmins, senior veterinary research officer, to be chief veterinary officer, Palestine.

MR. NORMAN NEVILLS will head an expedition of nine on a trip down the Green and Colorado Rivers, leaving Green River, Wyoming, on June 20, and arriving at Boulder Dam about August 25. The group will travel in three specially designed boats and make botanical and geological observations and collections in the little-known Canyon country. Dr. Hugh C. Cutler, of Washington University, is in charge of botanical research, and Mr. Nevills of the geological work.

THE Goethe Medal for Art and Science has been awarded to Heinrich Ewald Hering, formerly professor of physiology in the University of Cologne.

BY a recent decree the State has authorized the creation in French universities of faculties of pharmacy and the consequent granting of doctorates in pharmacy. By this action universities will rank pharmacy with the other four faculties—arts, law, sciences and medicine. Prior to this decree aspirants to high qualifications in pharmacy were awarded either a "doctorat d'Université, Mention pharmacie" or a "diplôme supérieur de pharmacie".

THE Council of the Royal Aeronautical Society has accepted an offer from Mrs. G. Alston to found a prize in memory of her husband Peter Alston who was killed in a flying accident on February 16, 1939. The prize, an annual one of approximately £5 in value, will be awarded for work aiming at the improvement of the safety of aircraft and particularly at improvement in stability and control, and such award is open to a student and/or graduate of the Society.

THE New York Academy of Sciences announces three prizes offered by Mr. A. Cressy Morrison, to be known as the A. Cressy Morrison Prizes I, II and III, all of which will be awarded in December 1940. Prize I, of five hundred dollars, will be awarded for the best paper on solar and stellar energy. Prizes II and III will be awarded for the best papers on a scientific subject included within the field of the New York Academy of Sciences and its affiliated societies. The competition for Prize I is open to all. Prizes II and III are limited to members of the New York Academy of Sciences and affiliated societies, but non-members may become eligible by joining one of these organizations before the closing date. Further information can be obtained from the Secretary, New York Academy of Sciences, Central Park West at 79th Street, New York City.

WHEN dealing with Dr. Haddon's second expedition to the Torres Straits (NATURE, June 1, p. 849) reference was made to Haddon's visit to New Guinea "with Ray and Seligman"; Prof. Seligman informs us that this should read "with Ray, Wilkin and Seligman".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 940.

The Electronic Charge

THE determination of e by a new oil drop method in which the electric field is horizontal[1] has been completed. The expression for e in terms of the quantities measured is similar to that which applies to H. A. Wilson's method and is

$$ne_1 = 9\sqrt{2}\ \eta^{3/2}\ (\rho-\sigma)^{-1/2}\ g^{-1/2}\ v_g^{\ 1/2}\ v_x\ X^{-1}. \quad (1)$$

The correction for the departure from Stokes's law is obtained from Millikan's relation

$$e_1^{2/3} = e^{2/3} + m/pa, \quad (2)$$

where $e_1^{2/3}$ is calculated from (1) and p cm. of mercury is the pressure and a is radius of the drop (cm.). The oil drops used are larger than those used by previous experimenters, and their velocity of fall being large, their motion was recorded photographically using exposures of 0·0005 sec. at intervals of 1/25 sec. The velocity of free fall, v_g cm./sec. and the velocity in the direction of the electric field v_x cm./sec., could be estimated with satisfactory accuracy. The electric field was obtained by means of a stabilized rectifier designed by Mr. T. P. Gill[2] and was measured by potentiometer methods in terms of Weston cells calibrated by the National Physical Laboratory.

Assuming $\eta_{23} = 1{,}830 \times 10^{-7}$ C.G.S. units, the value of e obtained is $(4{\cdot}8020 \pm 0\ 0013) \times 10^{-10}$ E.S.U. The probable error calculated by the theory of least squares is about one third of that obtained by Millikan, whose result becomes $e = (4{\cdot}7992 \pm 0{\cdot}0037) \times 10^{-10}$ E.S.U. when the above value of η_{23} is assumed. Millikan's 0·03784 and our value 0 03777 of m are in agreement within the smaller probable error. There are two other determinations of e by the drop method, namely, by Bäcklin and Flemberg[3], and by Ishida, Fukushina and Suetsuga[4]. Their results yield $4{\cdot}781 \times 10^{-10}$ and $4{\cdot}835 \times 10^{-10}$ E.S.U. for e respectively, when η_{23} is taken as $1{,}830 \times 10^{-7}$ C.G.S. units.

Careful determinations of e using the X-ray method have recently been made by several workers, and our reduction of their observations is given in Table 1

TABLE 1. X-RAY VALUE OF e.

Observer	$e \times 10^{10}$ E.S.U.
Soderman	4·8054
Bäcklin	4·8044
Bearden 1935	4·8029
1931	4·8049
Mean	4·8044 ± 0·0007

These results differ slightly from those given by the observers themselves, as we have used what we believe to be the most accurate values of antecedent data in the reduction of the results of the above observers.

It will be seen that the mean of the X-ray, $(4{\cdot}8044 \pm 0{\cdot}0007) \times 10^{-10}$ E.S.U., and of the oil drop determinations of Millikan and the authors, $(4{\cdot}8007 \pm 0{\cdot}002) \times 10^{-10}$ E.S.U., differ by $0{\cdot}0037 \times 10^{-10}$. The main uncertainty in the value of e as found by the oil drop method is in the value which is used for the viscosity of air. In the paper to be published describing the present determination, the errors in the measurement of η_{23} by the rotating cylinder and the capillary-tube method are discussed. The most precise results obtained by these methods are given in Table 2, and using the weights given, the mean is $\eta_{23} = (1{,}830{\cdot}06 \pm 2{\cdot}5) \times 10^{-7}$ C.G.S. units. In this table the values of the viscosity have been recalculated using Sutherland's expression,

$$\eta_\theta = \eta_{273}\{(273+c)/(\theta+c)\}\ .\ (\theta/273)^{3/2},$$

where $c = 117$, for the change in viscosity with temperature. This gives the change in viscosity per degree at 23° C. as $4{\cdot}83 \times 10^{-7}$ C.G.S. units and not $4{\cdot}93 \times 10^{-7}$ units as is generally assumed.

TABLE 2. VISCOSITY OF AIR.

Method	$\eta_{33} \times 10^7$	Weight
Rotating cylinder:		
Bearden	1833·8	4
Houston	1829·2	3
Kellström	1832·6	2
Harrington	1822·6	1
Gilchrist	1825·7	1
Capillary Tube:		
Rigden	1830·0	2
Bond	1834·6	1
Rapp	1822·7	1
Maxwell	1827·3	1

Weighted mean = $(1830{\cdot}06 \pm 2{\cdot}5) \times 10^{-7}$ C.G.S. units.

It will be noticed that the probable error of η_{23} calculated by external consistence contributes an error in e of 1 in 500 compared with an error of 1 in 3,000 in the remaining factors which enter into expression (1), an error larger than the difference between the oil drop and X-ray values of e. Thus the uncertainty in η_{33}, although a number of precision determinations of it has been made, contributes the major uncertainty to the oil drop determination.

We are attempting to determine the viscosity of air with, it is hoped, improved precision, using a method suggested by Fabry and Perot[5] in which there is a laminar flow of the air between optically flat disks.

It may be noted that using $e = 4{\cdot}802 \times 10^{-10}$, $h/e = 1{\cdot}3765 \times 10^{-17}$ (a mean of h/e determined by the X-ray method and by Wien's law) and

$c = 2{\cdot}99774 \times 10^{10}$, then $1/\alpha = hc/2\pi e^2 = 136{\cdot}76$. If Rydberg's constant (109,737·43) and e/m ($1{\cdot}7589 \times 10^7$) are substituted in the formula $1/\alpha = (c/4\pi R(e/m)e)^{1/3}$, it then becomes 137·03, which is nearly integral.

T. H. LABY.
V. D. HOPPER.

Natural Philosophy Laboratory,
University of Melbourne.
April 29.

[1] Laby, T. H., and Hopper, V. D., NATURE, **143**, 157 (1939).

[2] Gill, T. P., *J. Sci. Inst.*, **16**, 345 (1939).

[3] Bäcklin, E., and Flemberg, H., NATURE, **137**, 655 (1936).

[4] Ishida, Fukushina and Suetsuga, *Phys. Chem. Res. Tokyo*, **32**, 57 (1937).

[5] Fabry, C., and Perot, A., *Ann. Chim. et Phys.*, **13**, 275 (1898).

Mass Centre in Relativity

UNDER this title, in NATURE of April 13, p. 587, Prof. M. Born and K. Fuchs gave some relations between the total and a relative momentum vector of a system of two free particles. They only define the magnitude, not the direction of their relative momentum vector. I believe things become clearer by the following statement. Let V^a, W^a $(a = 0, 1, 2, 3)$ be $(1 + 3)$-dimensional velocity time-space vectors of the particles ($V^2 = W^2 = c^2$), and m_1, m_2 their scalar masses. Their individual energy-momentum vectors being $i_a = m_1 V_a$ and $j_a = m_2 W_a$, we may define the total energy-momentum vector by

$$I_a = i_a + j_a, \qquad (1, 1)$$

the relative energy-momentum vector by

$$S_a = (m_2 i_a - m_1 j_a)/(m_1 + m_2). \qquad (1, 2)$$

These definitions entail two identities

$$(m_1 + m_2)\,c^2 = \frac{I^2}{m_1 + m_2} + \frac{m_1 + m_2}{m_1 m_2}\,s^2, \qquad (2, 1)$$

$$0 = \frac{2m_1 m_2}{m_1 + m_2}\,(I.s) - (m_1 - m_2)s^2, \qquad (2, 2)$$

which are equivalent to equations (4), (5), (6) of Born and Fuchs.

The total energy-momentum has a time vector character, whereas the relative energy-momentum has a space vector character. The two individual rest masses, being constants of the motion, must be functions of the eight dynamical variables I_a and s_a:

$$c^2\,(m_1 + m_2)^2 = I^2 + 2s^2 + 2\sqrt{s^4 + (I.s)^2}, \qquad (3, 1)$$

$$c^2\,(m_1 - m_2)^2 = I^2 - 2\,\frac{s^2 I^2 - (I.s)^2}{s^2 + \sqrt{s^4 + (I.s)^2}} \qquad (3, 2)$$

As regards the centre of mass, which has completely been lost sight of in the communication referred to, I suggest that the proper thing to consider is a centre of inertia rather than a mass centre. The former must be defined with the aid of the bi-vectors of energy and momentum, i_a—or rather inertia and momentum, i^a—and radius vector, g^a. The components of this bi-vector are given by the determinants of the matrix

$$\left|\begin{matrix} i^{(0)} & i^{(4)} & i^{(2)} & i^{(3)} \\ g^{(0)} & g^{(1)} & g^{(2)} & g^{(3)} \end{matrix}\right|, \text{ say } A^{ab} = \left|\begin{matrix} i^a & i^b \\ g^a & g^b \end{matrix}\right|. \qquad (4, 1)$$

Take the sum of the bi-vectors of two particles, or of any number of particles, and we shall have the bi-vector

$$M^{ab} = \Sigma_{(n)} A^{ab}_n, \qquad (4, 2)$$

with six components, of total moment of momentum. Three of these components (for $a = 0$) define the moment of inertia relative to the origin.

The *inertia centre* must be defined as the *locus of origins* in time-space such as to make the moment of inertia vanish. To make the definition invariant, we require the moment of inertia to vanish in a Lorentz frame where the total energy-momentum vector is directed purely parallel to the time axis, so that *there is no resultant momentum*. Thus

$$M^{0b} = 0, \quad (b = 1, 2, 3) \qquad (4, 3)$$

In all other frames, that is, for a system of free particles showing resultant momentum, *we shall then find* a moment of inertia or, say, *a polarization of inertia*.

For any number of particles, first define $I^a = \Sigma_{(n)} i^a_n$. The determinants

$$P^{abc} = \Sigma_{(n)} \left|\begin{matrix} g^a_n & g^b_n & g^c_n \\ i^a_n & i^b_n & i^c_n \\ I^a & I^b & I^c \end{matrix}\right|, \qquad (5)$$

will represent the components of the tri-vector of *internal moment of momentum, multiplied by the magnitude of I.*

The dynamical variables here given were first published in 1927[1], and an illustration of the polarization of inertia is offered in the example of a rolling hoop[2] and a rotating ring[3].

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Teyler's Stichting,
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April 23.

[1] *Physica, Ned. T. Natuurk.*, **7**, 330 (1927). Fokker, "Relativiteitstheorie" (Groningen: Noordhoff, 1929).

[2] *Physica, Ned. T. Natuurk.*, **1**, 35 (1921).

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WE regret having overlooked Prof. Fokker's publications on the subject of the mass centre in relativity. His definition of the centre of inertia does not coincide exactly with our definition of the mass centre. Which definition is to be preferred depends, of course, on the use which can be made of it.

Our purpose was to separate from the Hamiltonian of a system of two particles that term which corresponds to the motion of the system as a whole, and to do it in such a way that the new variables form canonically conjugate pairs. We have shown how this can be done for two free particles by introducing the total momentum **P** and the internal momentum π; the canonically conjugate variables are **R** and ρ, as mentioned in our previous letter, though we did not give explicit expressions. Here **R** is to be interpreted as representing the position of the mass centre.

We have compared the two definitions and found that the mass centre coincides with the centre of inertia in the Lorentz system in which the total momentum vanishes. The two centres are therefore to some extent equivalent.

Although we readily agree that Prof. Fokker's definition is formally much more elegant, we cannot see that it is helpful for the quantum mechanical problem which we had in mind.

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Properties of Cytochrome *c*

A STRONG solution of pure cytochrome *c* obtained by the method which we have previously described[1] shows in the oxidized state an absorption spectrum of the parahæmatin type. In a very much higher concentration and in a thick layer this compound reveals the two additional feeble absorption bands at about 695 mμ and 625 mμ discovered by Yakushiji[2]. The absorption spectrum of oxidized cytochrome *c* changes with the hydrogen ion concentration[2,3]. In this respect, cytochrome *c* resembles other trivalent hæmatin compounds such as methæmoglobin, parahæmatin and hæmatin. It is known, for example, that a parahæmatin compound has a characteristic absorption spectrum only within a certain limited range of hydrogen ion concentration[4]. On acidifying it or on making it alkaline the absorption spectrum of parahæmatin changes respectively to those of free acid and free alkaline hæmatins.

Although in acid solution cytochrome *c* shows an absorption spectrum similar to that of a free acid hæmatin with a characteristic band at 625 mμ, in a strongly alkaline solution, instead of showing the spectrum of a free alkaline hæmatin, it shows the spectrum of a parahæmatin.

On reducing cytochrome *c*, in either strongly acid or strongly alkaline solution, a compound is invariably obtained with the typical absorption spectrum of reduced cytochrome *c*. The absorption spectrum corresponding to that of a free hæm of cytochrome *c* has not so far been observed.

Interesting changes in the absorption spectrum of cytochrome *c* can be observed by treating it with sodium dodecyl sulphate (S.D.S.), a powerful surface active substance previously used in connexion with the study of other proteins[5]. On mixing 1 c.c. of a strong solution of *c* with 0·1 c.c. of 5 per cent neutralized solution of S.D.S., the absorption spectrum of parahæmatin is rapidly replaced by that of acid hæmatin. However, sodium hyposulphite reduces this compound, not to the ordinary reduced cytochrome *c*, but to a derivative showing two feeble and more diffuse bands at 563 mμ and 530 mμ, of which the first is stronger than the second. This derivative is autoxidizable, and forms with carbon monoxide a stable compound with absorption bands at 562 mμ and 532 mμ, the second band being now as strong as the first.

The effect of S.D.S. on cytochrome *c* is reversible, as after removing this reagent by dialysis cytochrome *c* reverts to its original state. On the contrary, S.D.S. added to a colloidal heart muscle preparation containing the complete cytochrome system clarifies this preparation and irreversibly destroys all the components of the system except *c*.

The absorption spectrum of the divalent derivative of *c* obtained in this way resembles that of a free hæm. On the other hand, the fact that it cannot be separated from its protein by either fractional precipitations, adsorptions or ultrafiltration shows that the hæm nucleus is still bound to the protein.

This derivative can therefore be considered as a hæm-protein compound, in which the protein has probably lost its connexion with the iron although it remains still linked with the porphyrin.

A similar compound can be obtained from methæmoglobin not treated with S.D.S. but acidified until the bands of acid hæmatin appear. On reduction with sodium hyposulphite this derivative, instead of forming hæmoglobin or hæmochromogen, gives a compound with the absorption spectrum of a hæm. On the other hand, when methæmoglobin is treated with S.D.S. it turns at once into a parahæmatin, which on reduction gives an ordinary globin hæmochromogen.

These observations strongly support the view that the protein and the prosthetic group in cytochrome *c* as well as in other natural hæmatin-protein compounds are bound by means of several links of very unequal stability and which are affected reversibly or irreversibly by different factors modifying simultaneously the general properties of these compounds.

The nature of these links in cytochrome *c* is, however, far from being understood, and this is not surprising considering how very little is known of the nature of links uniting hæm with globin in the hæmoglobin molecule.

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May 13.

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A Crystalline Albumin Component of Skeletal Muscle

THE intracellular protein components of skeletal muscle are known generally as myosin, globulin *X*, myogen and myoalbumin. Myosin, the globulin which is probably directly related to the contractile process, is the major component, according to analyses carried out on rabbit and fish muscle. The remaining components have not been well characterized as individual proteins. For this reason it seemed desirable to attempt the crystallization of muscle albumin (myogen), adopting the technique employed by McMeekin[1] for the separation of the serum proteins.

A CRYSTALLINE ALBUMIN FROM RABBIT MUSCLE. (*c*. × 260.)

The crystalline albumin eventually obtained from rabbit muscle was crystallized from ammonium sulphate solutions of molarity 2·7–3·1 (65–75 per cent saturated) adjusted to *p*H 5·8 with sulphuric acid. Crystals identical in form have been obtained both from the potassium chloride extract employed by Edsall[2] for the preparation of myosin and also from muscle press juice. They consist of thin colourless plates, birefringent in polarized light, and exhibiting a pronounced sheen on agitation. The protein readily denatures on heating to 50°, by shaking, or by reducing the acidity to *p*H 5. Its iso-electric point is near *p*H 6.

Sedimentation and diffusion experiments on the crystal sample shown in the accompanying figure have been carried out through the kindness of Dr. E. J. Cohn, of the Harvard Medical School. They indicate a molecular weight of 155,000, a value which is provisional until other samples have been analysed.

During the course of this investigation, carried out in the summer of last year at the Woods Hole Marine Biological Station, Mass., Baranowski[3] reported from the laboratory of Parnas the crystallization of two albumins, myogens *A* and *B*. These he obtained from that fraction of press juice precipitating between 40 and 60 per cent saturation with ammonium sulphate. Myogen *A*, crystallizing in the form of hexagonal bipyramids, was studied in some detail, and Gralén[4], from sedimentation and diffusion experiments, assessed its molecular weight at 150,000. Myogen *B*, on the other hand, was sometimes fortuitously obtained from the mother liquors, and no method could be given for its preparation. Although our albumin separates at somewhat higher ammonium sulphate concentrations than those employed by Baranowski, it seems probable from his description that myogen *B* and our protein may be identical. To none of these albumins has any physiological activity as yet been assigned.

Further studies on the albumin will shortly be resumed.

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Thyroid Gland and Potassium Metabolism

IN experimental thyrotoxicosis as well as in Graves' disease, there is a marked disturbance of the carbohydrate metabolism. The sugar tolerance is often lowered and glycosuria may develop. Griffiths[1] reports that in cases of Graves' disease a high-grade insulin insensitivity may be found, and that such insensitivity is diminished by thyroidectomy. It is also well known that after administration of thyroid gland or thyroxine the liver glycogen disappears and cannot be restored by administration of sugar[2].

In recent years a close correlation has been found between potassium metabolism and carbohydrate metabolism[3]. It was now established that in experimental thyrotoxicosis the carbohydrate metabolism and the potassium metabolism are both affected. This is especially true with regard to the potassium and carbohydrate content of the liver. The liver of normal white rats contains about 1·7 per cent potassium. Administration of thyroid hormone causes a rise in liver potassium to 3–5 per cent and more, varying with the degree of thyrotoxicosis.

As with adrenalectomized animals, the hyperthyroidized animals are very sensitive to a high potassium intake. A food rich in potassium produces in hyperthyroidized animals a rapid fall of the body weight, loss of appetite, accompanied by a high degree of excitability and finally death.

It seems that, besides the adrenal cortex, the thyroid gland is also involved in the regulation of the potassium metabolism.

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May 4.

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Effect of Radiations on Bacteriophage C_{16}

IT has been shown previously[1] that the effect of X-rays on phages is in relation to particle size, as determined by ultra-filtration and ultra-centrifugation analysis: the larger the particle size, the greater is the sensitiveness of the phage to radiation.

We have undertaken a quantitative analysis of this phenomenon, and are dealing here with the effect of different radiations on phage C_{16} (F. M. Burnet)[2], which is active on dysentery bacillus Y_{6R}. Its diameter, as determined by Elford and Andrewes, is 50–75 mμ.

The following radiations have been used: (1) monochromatic X-rays of 17 kv. (K_α line of molybdenum); (2) non-monochromatic hard X-rays (D.C., 200 kv.); (3) total radiation of radon + active deposit, dissolved in the phage suspension. The effects on the phage were followed by the plaque count method, which

D (r units)	N/N_0	$\sigma = \dfrac{-\log_e N/N_0}{D}$	$N/N_0 = e^{-\bar{\sigma}D}$ (calc.)
X-rays 17kv.			
$5\cdot0\times10^{3}$	0·83	$3\cdot72\times10^{-5}$	0·89
10^{4}	0·80	$2\cdot23\times10^{-5}$	0·80
$3\cdot0\times10^{4}$ (2 exp.)	0·56	$1\cdot92\times10^{-5}$	0·52
$4\cdot0\times10^{4}$	0·40	$2\cdot29\times10^{-5}$	0·41
$6\cdot0\times10^{4}$	0·35	$1\cdot75\times10^{-5}$	0·26
$7\cdot5\times10^{4}$	0·24	$1\cdot90\times10^{-5}$	0·19
$9\cdot0\times10^{4}$	0·16	$2\cdot03\times10^{-5}$	0·14
		$\bar{\sigma} = 2\cdot22\times10^{-5}$	
X-rays 200 kv.			
10^{4}	0·79	$2\cdot35\times10^{-5}$	0·775
$2\cdot0\times10^{4}$	0·64	$2\cdot23\times10^{-5}$	0·60
$4\cdot0\times10^{4}$	0·42	$2\cdot71\times10^{-5}$	0·36
$6\cdot0\times10^{4}$	0·21	$2\cdot58\times10^{-5}$	0·22
$7\cdot5\times10^{4}$	0·15	$2\cdot53\times10^{-5}$	0·15
$9\cdot0\times10^{4}$	0·075	$2\cdot85\times10^{-5}$	0·10
		$\bar{\sigma} = 2\cdot54\times10^{-5}$	
Radon (α-particles + β-rays)			
$5\cdot2\times10^{4}$ (2 exp.)	0·86	$2\cdot88\times10^{-6}$	0·79
$7\cdot3\times10^{4}$ (2 „)	0·70	$4\cdot88\times10^{-6}$	0·71
$11\cdot1\times10^{4}$ (1 „)	0·51	$6\cdot05\times10^{-6}$	0·59
$12\cdot2\times10^{4}$ (2 „)	0·58	$4\cdot37\times10^{-6}$	0·56
$17\cdot7\times10^{4}$ (2 „)	0·45	$4\cdot51\times10^{-6}$	0·44
$23\cdot3\times10^{4}$ (3 „)	0·28	$5\cdot45\times10^{-6}$	0·33
$37\cdot6\times10^{4}$ (2 „)	0·14	$5\cdot20\times10^{-6}$	0·17
$52\cdot5\times10^{4}$ (3 „)	0·09	$4\cdot60\times10^{-6}$	0·08
		$\bar{\sigma} = 4\cdot69\times10^{-6}$	

practically corresponds to counting the number of active particles present in the samples[3].

The results, shown in the accompanying table, may be summarized as follows:

(1) For all the radiations used, the proportion N/N_0 of active particles diminishes exponentially as dose D increases:

$$N/N_0 = e^{-\sigma D}. \quad (1)$$

It will be seen from the table that the values N/N_0 experimentally found are in very good agreement with those calculated on the assumption of an exponential law.

(2) The effect of radiations on phage is a function of the dose $D = I.t$, and does not depend on its components I (intensity) and t (time of exposure).

(3) The doses of X-rays being expressed in r units ($lr = 2 \times 10^9$ ions/cm.^{3} in air), equal doses of different wave-length rays produce the same effect.

(4) With α-particles a dose[4] seven times larger than with X-rays must be used in order to produce the same effect.

These results can be explained in terms of the 'target hypothesis'[5], in the following way.

A phage particle is inactivated by a single 'hit', as shown by the exponential inactivation rate. The independence of the wave-length in the case of X-rays shows that this hit is an elementary ionization process (single ionization, or (Jordan[6]) small groups of 2·2 ions in the average).

The relationship (1) allows us to calculate the value of σ. If we express the doses in ions (or in ion groups) per volume unit, σ has the dimensions of a volume ('action volume'): all the ionizations produced in this theoretical volume—and those only—are effective. In the case of X-rays the action volume has a radius of 14 mμ (doses expressed in ions) or 18 mμ (doses in ion groups). With α-particles the radius is reduced to 7·5 mμ (doses in ions).

In comparing the dimensions of the phage particles, as determined by ultra-filtration and ultra-centrifugation, with the calculated action volume, it should be borne in mind that the latter are by themselves but expressions of probability: we may imagine, for example, an action volume σ',n times larger, in which an ionization process is followed by inactivation with a probability $p = 1/n$; ($\sigma = p\sigma'$).

However, the fact that the calculated action volume is smaller in the case of radiations which produce a very dense ionization (α-particles), shows that the action volume corresponds to a really existing 'sensitive volume'[6]. When the distance between two ionizations is smaller than the dimensions of this sensitive volume, a part of the ionization process is ineffective for the biological action: correspondingly more energy must be absorbed, in order to produce the same effect. The sensitive volume will have, as lower limit, the dimensions of the action volume calculated for hard X-rays, and will be equal to it, if $p = 1$.

On the other hand, in the case of the very densely ionizing α-particles, it seems reasonable to think that the collision of such a particle with the sensitive volume is surely an effective 'hit'. Then, if we express doses in α-trajectories per surface unit, the value of σ from relationship (1) gives us the cross-section for this collision. The cross-section would have a radius of about 50 mμ. Deducting from that the radius of the ionization column produced by the α-particle (about 20 mμ; Jordan[7]), we find for the sensitive volume a radius of 30 mμ, in rather good agreement with the radius of the phage particles as given by ultra-filtration.

On the whole, our results tend to prove that phage inactivation is an elementary quantic process. They are in agreement with the view that phages, as well as certain viruses, are monomolecular structures: the inactivation should be conceived as a quantic transition of such a molecule. In this respect, our results are closely similar to those obtained by Timofeeff-Ressovsky[8] on gene radio-mutations in Drosophila.

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May 4.

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[2] We owe this phage and the sensitive strain to the kindness of W. J. Elford.

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Nitrogen Fixation in the Rice-Field Soils of Bengal

It has been proved by several workers by means of pure culture experiments that fixation of atmospheric nitrogen may take place by the activity of some algæ, specially members of the group Myxophyceæ. On the mucous sheath of most of these algæ bacteria are generally present quite abundantly. Many of these are found to be Azotobacter, Clostridium and other nitrogen-fixing bacteria which are ordinarily distributed in the soil. Pure culture technique has been employed by recent workers to find out whether the bacteria and the various algæ by themselves independently or jointly (symbiotically) carry on nitrogen-fixation work.

Kossowitsch[1], using pure cultures, came to the conclusion that nitrogen-fixation could not be carried out by the algæ by themselves, but only when contaminated by bacteria, and suggested a symbiotic relation. Similar conclusions were arrived at by Bouilhae[2], Bouilhae and Giustiniani[3] and Schramm[4]. On the other hand, Molisch[5] isolated a pure Nostoc which could grow in a nitrogen-free solution. Allison and Hoover[6], Allison, Hoover and Morris[7] and Copeland[8] have ascribed power of nitrogen fixation to Nostoc, and to other Myxophyceæ. In India, the presence of algal scum in water-logged paddy fields has been found by Sen and others[9], working with alluvial soil of Faridpur, Bengal, to be associated with increase in nitrogen content. All workers agree that the agency responsible for fixation of nitrogen in these soils is of a biological nature. Recently Fritsch and De[10] and De[11], using bacteria-free unialgal cultures of certain Myxophyceæ isolated from soil samples taken from Faridpur rice fields, came to the conclusion that a considerable quantity of atmospheric nitrogen was fixed by some of these Myxophyceæ and even when these were mixed with Azotobacter, the amount of nitrogen fixed did not increase; hence they concluded that the bacteria play a relatively unimportant part in nitrogen-fixation in the rice-fields.

Working with soil samples from the same paddy fields of Faridpur, sent to me by Sir Bryce Burt, I came to somewhat different conclusions[12]. I found that quite a considerable amount of nitrogen was fixed by the Azotobacter isolated from the mucous sheath of the algæ growing on these soils and that the amount of nitrogen fixed did not increase when the contaminated algæ were put in the culture flasks. From observations in the paddy fields, I conclude that the algæ play a relatively unimportant part in a direct manner in fixing atmospheric nitrogen in the rice fields, but indirectly this action is of the highest importance.

When the algæ die, they provide an enormous mass of growth medium on which these bacteria thrive so well. The limited number of bacteria present in the mucous coat of these Myxophyceæ now start rapidly multiplying. The conditions for growth are very favourable at this time and a large quantity of nitrogen is now fixed by these well-known nitrogen-fixers, leading to the increase of nitrates in these soils. When under favourable conditions the algæ were multiplying, much of the nitrate formed was utilized by the algæ themselves. It is only after the death of the algæ (and it may be mentioned that they die *en masse* when the water begins to dry up and the fields are not flooded any more after the crop has been harvested) that this rapid multiplication of bacteria takes place leading to the enormous increase of soil nitrates. Thus the action of these algæ in the matter of nitrogen-fixation in the rice-fields of Bengal is, I believe, indirect, the bacteria being primarily responsible for the fixation of the atmospheric nitrogen.

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Lahore. April 22.

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Salt Accumulation and Plant Respiration

THE recent discussions in NATURE between Lundegårdh[1,2] and Hoagland and Steward[3,4] have shown that Lundegårdh's conclusions, based on his own experimental results, are not acceptable to Hoagland and Steward, who have used other types of plant material and a different technique. While it would be surprising if the results obtained with one type of plant material could be replicated exactly for other types, Lundegårdh's suggested mechanism may be applicable to other tissues; Hoagland and Steward do not succeed in disproving Lundegårdh's interpretation of his data. In view of the fact that Hoagland and Steward found it necessary to suspend judgement on the reality of the anion respiration coefficients on which Lundegårdh's conception largely depends, the following data are of interest.

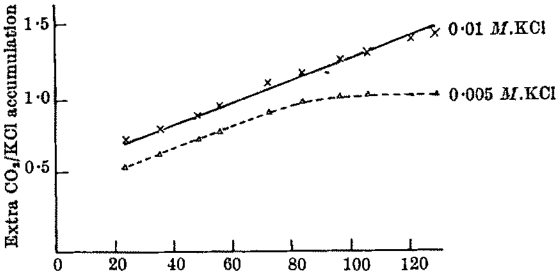

Fig. 1.

Recent work in this laboratory on cut carrot tissue under controlled conditions gives qualitative support to Lundegårdh's conclusion that there is a definite relationship between the amount of salt accumulated and the extra carbon dioxide evolved. The relationship, in carrot tissue, differs quantitatively from that obtained by Lundegårdh with other plant material. According to Lundegårdh's interpretation

$$R_T = R_G + kA,$$

where R_T is the total respiration, R_G is that respiration which occurs independently of the mechanism of ion absorption and kA is the anion respiration which is a multiple, k, of the anion absorption A. In the work done in this laboratory with carrot tissue, the net amounts of different metallic chlorides accumulated and the total carbon dioxide evolved were

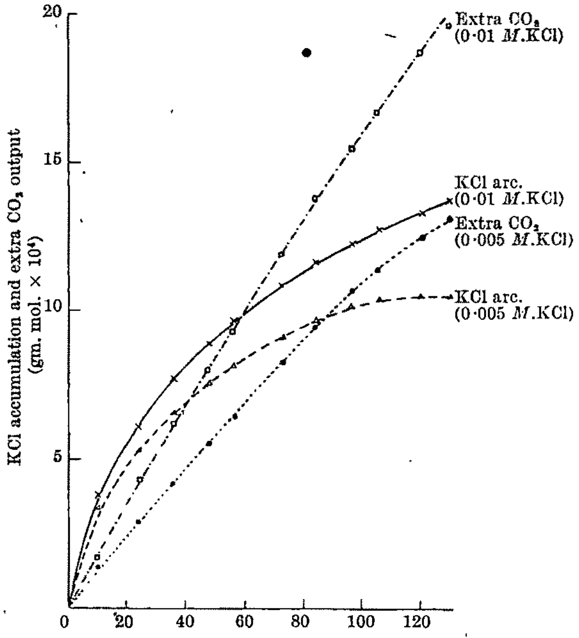

Fig. 2.

THE KCl ACCUMULATION AND EXTRA CARBON DIOXIDE OUTPUT FOR TWO COMPARABLE SETS OF TISSUE, UNDER CONTROL CONDITIONS, ONE IN 0·01 *M*.KCl AND THE OTHER IN 0·005 *M*.KCl. ACCUMULATION FROM THE MORE DILUTE SOLUTION CEASED WHEN ALL THE KCl WAS ABSORBED AFTER ABOUT 120 HOURS.

simultaneously determined. Taking the carbon dioxide production due to the salt as the total in the presence of salt less the total in distilled water, the ratio $\frac{\text{salt respiration}}{\text{salt absorption}}$ can be obtained. This is the same as Lundegårdh's k though its absolute value may differ slightly if, as Lundegårdh suggests, the respiration in distilled water is not the same as the R_G. This ratio, unlike that obtained by Lundegårdh, has not been found to be "fairly constant if the anion absorption is varied by variation in the concentration of a single salt". The ratio varies both with concentration absorbed and with time.

It is seen (Fig. 1) that the ratio increases from 0·75 in the early stages to 1·5 in the later stages and remains constant only when, as in the case with the 0·005 $M.$ solution, all the salt has been absorbed from the external solution. The reason for the increase in the value of the ratio is to be found in the decreased rate of accumulation of the salt with time. The rapid initial accumulation, followed by a lower rate of accumulation which changes only slightly over a long period, has been established as characteristic of carrot tissue (Briggs and Robertson)[5] and is similar to that obtained with high salt barley roots (Hoagland and Broyer)[6]. The respiration, having reached its maximum within two hours of the addition of the electrolyte, decreases negligibly during the rest of the experiment (Fig. 2). In the case of the lower concentration of salt, the carbon dioxide production remains high in spite of the fact that all the salt has been absorbed. From these results it is clear that the salt respiration cannot be expressed as a linear function of A; it could be expressed as a function of A and t.

The difference between this result and that of Lundegårdh may be due to the difference in the plant tissues, but it is also possible that Lundegårdh did not obtain the same relationship because his results are all for short periods and over a concentration range where the amount absorbed is probably limited by concentration. At higher external concentrations the amount absorbed tends to be independent of concentration. The fact that the ratio remains high even after absorption has ceased indicates that the extra carbon dioxide is related not only to the ions being absorbed but also to the internal concentration being maintained. The fact that the amount of extra carbon dioxide per amount of ions absorbed increases as the absorption falls may be in accord with Lundegårdh's idea that the more difficult it is for cations to enter, the more energy is required to balance the accumulation of the anions. Other results obtained with sodium, lithium, magnesium and calcium chlorides confirm Lundegårdh's conclusion that the ratio of extra carbon dioxide production to amount absorbed increases with the decreased mobility of the cations in the protoplasm. The divalent chlorides give much greater ratios than do the monovalent.

It is hoped to publish this work in full shortly.

R. N. Robertson.

Botany Department,
University,
Sydney. April 1.

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[1] Lundegårdh, H., Nature, **143**, 203 (1939).

[2] Lundegårdh, H., Nature, **145**, 114 (1940).

[3] Hoagland, D. R., and Steward, F. C., Nature, **143**, 1031 (1939).

[4] Hoagland, D. R., and Steward, F. C., Nature, **145**, 116 (1940).

[5] Briggs, G. E., and Robertson, R. N., unpublished data; work done at Botany School, Cambridge, 1937–38.

[6] Hoagland, D. R., and Broyer, T. C., *Plant Physiol.*, **11**, 471 (1936).

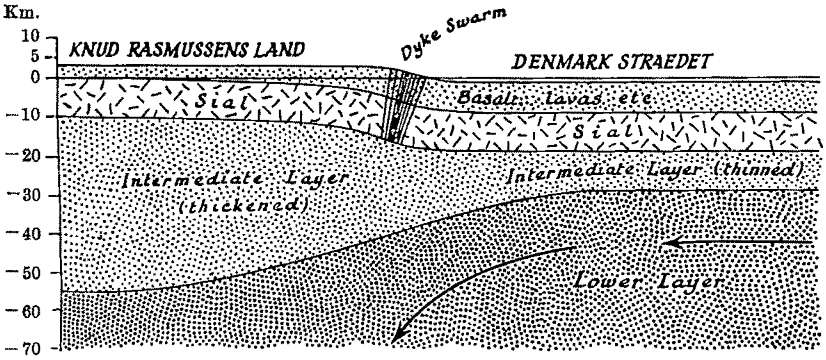
Epeirogenic Earth Movements in East Greenland and the Depths of the Earth

Satisfactory geological evidence that the earth's crust has undergone powerful vertical movements unaccompanied by horizontal compression has seldom been obtained, and Daly[1] has recently given it as his opinion that such movements have not been sufficiently well proved to be taken into consideration in attempts to understand the nature of the earth's interior. During recent expeditions to East Greenland geological mapping has shown that the coastal mountains from lat. 66–70° N. were produced by a powerful, and geologically rapid, vertical uplift. Between the Denmark Strait and the adjacent mountain belt of East Greenland the relative vertical movement of the crust amounted locally to at least 3½ km. and was but little less over the whole stretch of 800 km. Such a displacement must be regarded as a major tectonic feature of the earth's crust and merits brief description as the full account, prepared for a Danish journal, cannot be published at present.

In late Cretaceous times much of this part of East Greenland was at about sea-level and some marine Senonian sediments were laid down. These were succeeded by the extrusion of basalts which, in places, accumulated to a thickness of at least 7 km. During middle Eocene times powerful uplift took place which gave rise to what is now the highest part of coastal Greenland, while down-sinking of the area to the east gave the Denmark Strait. The rocks between these regions of opposite radial movement were bent into a flexure. During the flexuring a dense dyke swarm[2] was injected which allows the age of the earth-movements to be fixed and shows that tension then existed in the upper crust. Folding, overthrusting or other evidence of compression are entirely lacking. The widespread and powerful radial earth-movement in East Greenland, which may be described as epeirogenic since there is no evidence that it was a secondary result of tangential compression, emphasizes by its magnitude the importance of vertical crustal movements of the kind which take place without tangential compression.

Phenomena of this kind must either be left unexplained or some hypothesis must be advanced involving the deeper layers of the earth. Since so little is known about the depths of the earth a range of hypotheses is possible. For this particular case du Toit[3] has suggested one which is based on the paramorphic principle, but while this might explain the downsinking of the Denmark Strait where a great thickness of basalts accumulated, it cannot account for the uplift of the adjacent land which was also covered by basalts, though less thickly. A more satisfactory hypothesis seems to be that of migration of subcrustal material followed by adjustment to isostatic equilibrium. This view was suggested when the dyke swarm was briefly described[4], and part of the uplift was explained as a result of migration of the lower part of the sial layer. If, however, the whole of the vertical movement is to be accounted for by migration of material in depth, then it is necessary to postulate a greater movement of some subcrustal layer than was previously suggested.

At the time of these movements in East Greenland, the crust was capable of tension fracturing, at any rate where the dyke swarm was developed, and compressive forces were nowhere sufficient to cause



folding or thrusting in the visible part of the crust. The dykes occupying the tension fractures are of basaltic composition indicating that basic magma and not acid was then available. The change from a crustal layer, capable of being thickened or thinned by flow, to an overlying layer which remained unaffected is likely to have taken place where there was a sharp change of composition. For these reasons it seems likely that during the epeirogenic movement in East Greenland an intermediate layer of basaltic composition was changed in thickness, while the overlying sial layer remained unaffected (see accompanying illustration). The migration of material may have been effected by the drag of convection currents in a lower layer; several indirect lines of evidence, recently summarized by Gutenberg[5], now suggest the existence of such currents.

The process described above is capable of producing by direct sinking an ocean basin such as the North Atlantic, and yet it is not at variance with the theory that the earth's crust is in isostatic equilibrium. New evidence for the hypothesis that the North Atlantic has been formed in part by direct sinking is provided by the recent work on submarine geology and topography summarized by Field[6].

L. R. WAGER.

Department of Geology,
University of Reading.
April 26.

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[1] Daly, R. A., "Physics of the Earth VII", 58 (New York and London 1939).

[2] Wager, L. R., and Deer, W. A., *Geol. Mag.*, 75, 39 (1939).

[3] du Toit, A. L., *Geol. Mag.*, **75**, 189 (1939).

[4] Wager, L. R., and Deer, W. A., *Geol. Mag.*, **75**, 46 and Fig. 3 (1939).

[5] Gutenberg, B., "Physics of the Earth VII", 184 (New York and London, 1939).

[6] Field, R. M., *Trans. Amer. Geophys. Union*, Part 1, 20 (1936).

Surnames, Intelligence and Fertility

IN a recent communication[1], Prof. R. A. Fisher and Dr. Janet Vaughan showed that a significant racial difference in blood-group frequencies could be detected in a sample of Liverpool donors by comparing with the whole group those possessing characteristically Welsh family names. This has prompted me to make a similar comparison for intelligence, as estimated by a mental test, in the case of a practically complete sample of school-children living in the city of Bath. The results may be of interest in view of the scarcity of observations made under conditions likely to ensure a fair comparison of racial groups. Furthermore, it has sometimes been suggested that Welsh immigrants in English cities tend to be of lower average intelligence and greater fertility than the native populations; in this connexion see, for example, Cattell[2].

The sample of Bath schoolchildren consists of those whose dates of birth fell between September 1, 1921, and August 31, 1925, inclusive, and who were living within the city boundaries on July 27, 1934. Extremely few children escaped the ascertainment and mental testing; full details have been published[3]. The scale used was the Advanced Otis and the results are expressed in terms of an 'Index of Brightness', or *I.B.*, which is simply a device for adjusting scores so as to allow for varying age at test. The norms were established on the group itself. The number of children is 3,361.

For the selection of Welsh family names I am much indebted to Mr. B. S. Bramwell, of the Society of Genealogists. In a paper[4] in which he made certain interesting racial comparisons he used family names for differentiating groups. He gave a list of 33 characteristically Welsh names. Of these, 24 are represented in the index of Bath children: Davies, Edwards, Evans, Francis, Harris, Hughes, James, Jenkins, Jones, Lewis, Lloyd, Morgan, Morris, Owen, Parry, Phillips, Powell, Price, Pritchard, Richards, Roberts, Thomas, Williams and Willis. To increase the numbers I submitted to Mr. Bramwell a further list of names taken from the Bath index. Of these he selected ten: Griffiths, Howell, Howells, Humphries, John, Owens, Probert, Pugh, Rice and Vaughan. The number of children bearing these family names is 213, 6·3 per cent of the whole group.

COMPARISON WITH THE REMAINDER OF CHILDREN BEARING WELSH FAMILY NAMES.

	No.	Mean Otis *I.B.*	Standard deviation	Standard error of mean
Welsh family names	213	102·9	36·4	2·5
Remainder	3148	99·8	34·7	0·6

The difference in mean performance, 3·1, is not significant, being only 1·2 times its standard error. The difference between the standard deviations is not significant either, being less than its standard error. The frequency curve for the children with Welsh names is closely similar to that for the remainder, and does not depart significantly from the normal form.

In regard to fertility, taking as a measure the number of living full brothers and sisters (at the time the information was obtained), the Welsh children have an average of 2·46 sibs, while the remainder have 2·59. The difference is not significant. (Full data have recently been published[5] on the fertility of Welsh migrants in the city of Oxford.)

It can safely be concluded that whatever racial characteristics distinguish the Bath citizens who are of Welsh origin, a lower average level of general intelligence and a higher fertility are not among them.

J. A. FRASER ROBERTS.

Burden Mental Research Department,
Stoke Park Colony,
Bristol.
May 7.

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[1] NATURE, **144**, 1047 (1939).

[2] Cattell, "Psychology and Social Progress", pp. 53, 96, 99, 102, 125–26 (1933).

[3] Roberts, Norman and Griffiths, *Ann. Eugenics*, 8 (1938).

[4] Bramwell, *Eugenics Rev.*, 15 (1923–24).

[5] Daniel, *Sociol. Rev.*, 31 (1939).

History of the Vacuum Flask

WHILE fully accepting all that Mr. Gabb writes in NATURE of June 1 about matters of fact within his knowledge, I am still of opinion that Lennox made the first vacuum test tubes and flasks by methods of his own. Those I saw on his bench were transparent (unsilvered), and, having watched both him and Muller at work, I consider that he was quite as capable of doing it as Muller.

My father's assistant, Gordon, who was working at the Royal Institution at the time, clearly stated to me that Lennox arrived at his methods by trials which he, Gordon, had witnessed.

Mr. W. J. Green, of the Royal Institution, writes to me (May 2, 1940):

"Mr. Heath [Dewar's second assistant] told me quite definitely that Lennox made the first vacuum vessels in the laboratory, and further that he passed on his methods to outside people who were asked to supply in addition to what the laboratory could make."

RAYLEIGH.

Terling Place,
Chelmsford.
June 2.

Photolysis of Acetaldehyde

IN a recent paper on the high temperature (300° C.) photolysis of acetaldehyde[1], it is suggested that earlier work[2] based on measurements of pressure change may be unreliable on account of possible polymerization.

We have followed the course of this photolysis by chemical analysis for acetaldehyde at various stages, using the method of Friedemann, Cotonio and Shaffer[3]. The rate of decomposition of the aldehyde measured in this way agrees exactly with the observed pressure change, as is shown in the following example:

Initial acetaldehyde pressure: 100 mm. Temperature: 300° C.

Time (min.)	Observed pressure change (mm.)	CH_3CHO decomposed (by analysis)
0	0	0
1	+ 6·7	6·8
2	+ 12·8	12·7
3	+ 17·3	17·1
4	+ 20·5	21·0
5	+ 25·0	25·0

These results, coupled with the fact that a pressure increase of practically 100 per cent is observed on prolonged irradiation, shows that no appreciable polymerization takes place under these conditions. There is hence no reason to doubt the accuracy of the earlier work.

C. J. DANBY.

Department of Physical Chemistry,
Oxford.

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[1] Grahame and Rollefson, *J. Chem. Phys.*, **8**, 98 (1940).

[2] Mitchell and Hinshelwood, *Proc. Roy. Soc.*, A, **159**, 32 (1937).

[3] Friedemann, Cotonio and Shaffer, *J. Biol. Chem.*, **73**, 342 (1927).

Points from Foregoing Letters

Using a new oil-drop method, T. H. Laby and V. D. Hopper have made a new determination of the electronic charge. They claim for the results a probable error one third of that of Millikan's determination, and state that it agrees with the value of the electronic charge by the X-ray method to the accuracy with which the viscosity of air is known.

A. D. Fokker, after indicating the dynamical variables for a system of two particles in relativity theory, presents Lorentz-invariant definitions for the centre of inertia and for the internal moment of momentum of a system of any number of free particles.

On treating cytochrome *c* with sodium dodecyle sulphate (S.D.S.) D. Keilin and E. F. Hartree find that a derivative is obtained which can be considered as a hæm-protein compound, in which the protein has probably lost its connexion with the iron although it remains still linked with the porphyrin. The effect of S.D.S. on cytochrome *c* is reversible, as after removing this reagent by dialysis cytochrome *c* reverts to its original state.

K. Bailey reports the crystallization of an albumin from rabbit muscle. Although obtained independently, it may be identical with the myogen *B* which Baranowski has occasionally obtained in the mother liquors of myogen *A*.

E. Wollman, F. Holweck and S. Luria have subjected a bacteriophage to the effects of various forms of radiation. Their results lead to the conclusion that inactivation of bacteriophage by irradiation is a quantum effect, and that the phage is a monomolecular structure.

Referring to recent work suggesting that certain algæ, particularly algæ from Indian rice fields, are able to fix atmospheric nitrogen, H. Chaudhuri states that his own work leads to the view that bacteria, living in the mucous sheath of these algæ, are responsible for nitrogen fixation.

R. N. Robertson, working on salt accumulation and respiration in cut carrot tissue, finds that the ratio of carbon dioxide produced in the presence of salt to the amount of salt absorption varies with concentration of salt absorbed and with time. His work supports Lundegårdh's views in relation to ionic absorption.

L. R. Wager describes a powerful Eocene flexure of the earth's crust which has recently been found in East Greenland. He suggests that it has resulted from variation in thickness of an intermediate layer of basaltic composition under the influence of convection currents.

In the high temperature photolysis of acetaldehyde C. J. Danby finds that the course of the reaction as followed by chemical analysis agrees exactly with the observed pressure change, which therefore gives an accurate measure of the reaction rate.

RESEARCH ITEMS

Shamanism in the South-West United States

AN account by Isabel T. Kelly of shamanism as practised by seven of the original fifteen bands of the Southern Paiute (*Anthrop. Rec.*, 2, 4, Univ. California Press, 1939) is based on field observations occupying eleven months in 1932–34. They are sufficiently full to permit formulation of a characteristic Paiute pattern, while bringing out local specializations. The outstanding common features may be outlined as follows. Shamans of either sex derive their powers from dreams, usually unsolicited. They confer with a familiar spirit, sometimes human, more frequently animal, from which they receive songs and instruction for curing. Neither powers, songs nor office are inherited. Sickness is attributed to intrusion of a material object or a ghost, or less commonly to soul loss. The last is cured by pursuit and restoration of the lost soul, the two former by sucking and song. All bands distinguish between the rattlesnake shaman and the general practitioner, and some recognize numerous other specialists. Paucity of material makes it difficult to place Southern Paiute shamanism with respect to that of either the Great Basin or other adjacent areas. Object intrusion is nearly universal in western North America in contrast to the relatively infrequent ghost intrusion. Emphasis on the guardian spirit is reminiscent of central California, while the idea of soul loss calls to mind Southern California. The closest specific resemblance is with the Havasupai. The difficulty of delimiting Southern Paiute with respect to surrounding areas is perhaps as significant as any other fact in evaluating it as characteristically Basin.

Aluminium Dust in Silicosis

SILICOSIS, the lung disease to which stone cutters and others who work in dusty trades are subject, has been noticed to develop in rabbits exposed to air containing moderate concentrations of fine quartz particles. In the *Bell Laboratory Records* of April, it is stated that this is completely prevented if there is as little as one hundredth as much aluminium dust as silica in the air breathed. This preventive action was discovered at the McIntyre Porcupine Mines, and has been ascribed to an extremely thin coating of an aluminium compound deposited on the silica particles. The action of the aluminium is sufficiently curious and important to justify a fuller understanding of the nature of the film which it forms upon quartz particles. Dr. Frary, director of the Aluminium Research Laboratories, suggested that the answer might be forthcoming if a study were made of electron diffraction patterns. In experiments carried on by L. H. Germer and K. H. Storks, a beam of high-speed electrons was passed through thin films of silica which had previously been exposed to aluminium and water at body temperature. The diffraction patterns obtained showed a layer of aluminium hydrate less than one millionth of an inch thick on the silica. Although extremely thin, this layer is sufficient to prevent the silica from injuring the lungs. Two very striking photographs are shown of electron diffraction patterns, one of aluminium hydrate on silica and the other of silica alone.

Medical Uses of Radium

THERE are probably not many who have been consecutive readers of the seventeen yearly reports, "Medical Uses of Radium", published by the Medical Research Council since 1923. They are interesting in retrospect as showing the gradual emergence of radium treatment from a qualitative to a quantitative basis, and in bringing to the reader the conviction that radium, properly used, is a valuable agent in the treatment of cancer and several other non-malignant conditions—witness the statistical data, evidently prepared with great care, which figure throughout the text of the current report (Spec. Rep. Ser. No. 236). The research side of this work under the ægis of the Council has grown year by year; only to enumerate the titles of the research work of different centres will give an idea of the way in which the science and art of radium treatment are being strengthened. These lines of investigation include studies upon artificial radioactivity, irradiation of gels and the polymerization of liquids, biochemical effects of radiation, the dependence of biological effects upon the wave-length, the concentration of radon at which it becomes harmful, the production of mutations in Drosophila and the formation of malignant growths in the rabbit as a result of prolonged radiation—such are the varied researches contributing to the growth of this subject.

Teart Disease in Cattle

A LARGE area of pasture in central Somerset and smaller areas elsewhere have been known for more than a century to cause scouring in ruminants, especially cows in milk and young stock. Such land in known locally as 'teart'. During the past four years an intensive study of the problem has been made by W. S. Ferguson, A. H. Lewis and S. J. Watson, and their results are now published in Bulletin No. 1 of the Jealott's Hill Research Station (Imperial Chemical Industries, Ltd.), Bracknell, Berks. The cause of teartness is the presence in the herbage of molybdenum, which is highest in green leafy material, particularly clovers and Yorkshire fog, considerably less in hay and very low in dead or frosted herbage. The land, therefore, can only be grazed with safety during the winter, and 'improvement' of the pasture only aggravates the trouble owing to the increase in clover. Scouring, however, can be entirely cured and prevented by feeding or drenching the stock with copper sulphate. 2 gm. per cow per day or 1 gm. for young stock is sufficient. Experiments conducted in America show that copper sulphate fed continuously at the above rates for a long period is not likely to have any harmful effect on stock. Experiments are in progress to see if the addition of copper compounds to the soil would be equally effective. As teartness increases under neutral or alkaline conditions, basic slag and lime should not be used; but sulphate of ammonia and ammonium phosphate fertilizers can be applied with safety. Reduction of teartness is also obtained by ploughing out and reseeding, and many of the affected pastures are being converted into arable land at the present time. Shallow ploughing is suggested to avoid bringing up the more teart subsoil.

Fauna of the Belgian Cretaceous

IN a recent memoir ("La Transgression albienne et cénomanienne dans le Hainaut", *Mém. Mus. Roy. d'hist. nat. Belgique*, No. 89 ; 1939) Dr. R. Marlière gives a monograph of the fauna of the Meule de Bracquegnies, followed by an account of the characters, distribution and stratigraphical relations of the Albian and Cenomanian deposits of Hainaut. The Meule de Bracquegnies rests on Carboniferous or Wealden, and is overlapped by Cenomanian and Turonian deposits ; its fauna was described by Briart and Cornet in 1868, and the present author makes many additions to their work. Except for the absence of ammonites, the fauna resembles closely that of the Blackdown Greensand, which is of the age of part of the Upper Gault. The lamellibranchs and gastropods, which form almost the entire fauna, are such as would live on the continental shelf in water of no great depth ; they include some dwarfed forms, which, in connexion with the almost entire absence of cephalopods, brachiopods and echinoderms, suggests some peculiarity in the composition of the sea water or in the nature of the sea floor.

Flora of the Belgian Lower Devonian

THE oldest fossil plants are scrubby little things that would scarcely be looked at twice if they came from a later formation, yet their study has been characterized by the utmost care and determination of the investigator to make the specimens yield every shred of information, and one might add by first-rate photography. The first account, apart from some piecemeal work, has just been published of the Lower Devonian flora of Belgium, and it at once makes it one of the richest (with about 25 species) and best known of its period ("Végétaux Éodévoniens de la Belgique", by F. Stockmans, *Mém. Mus. Roy. d'hist. nat. Belgique*, No. 93). Really well preserved plants like those of the Rhynie Chert have yet to be found in the Lower Devonian, but many interesting new points are added in this paper to the knowledge of these little-known types, particularly to Taeniocradia, in which sporangium-like organs are described. Petrified axes of the seaweed-like Prototaxites and with it, as usual, the enigmatic sphere Pachytheca (held by some to be a fish's eye and some an alga) are described from this region also, but they do not seem to occur much in association with undoubted land plants.

Classification of Pears

IN a preliminary report (*J. Pom. and Hort. Sci.*, **18**, 52 ; 1940) M. B. Crane and D. Lewis have described a system for the classification of cultivated pear varieties, based on the morphological characters of leaves and shoots. The characters used have been shown by breeding experiments to be genetically controlled, and though some of them show seasonal variations, they can be used with confidence when the range of variations is known. Leaf-margin, midrib, shoot-hairiness and shoot and leaf colour are the characters concerned. Spur-leaf margins may be toothed, serrate-crenate, or entire. Leaf midrib may be glandular or without glands, the mean number per leaf being characteristic for a variety. Shoots may be red-purple or green, and hairy, sparsely hairy or glabrous. Leaves are either green or pale green. All these characters are reliable and not affected by rootstock. It is hoped eventually to include flower and fruit characters in the classification.

Irregular Division of the Centromere

C. D. DARLINGTON (*J. Genetics*, 39, 351–361 ; 1940) has analysed the chromosomes of species of Fritillaria and shown that chromosomes with telocentric centromeres arise by a transverse division of the centromere in a two-armed chromosome. Such telocentric chromosomes may give rise to iso-chromosomes by the chromatids opening out to form a two-armed chromosome. The author discusses the effect of these phenomena on the mechanical properties of the chromosome.

Infra-Red OH Band and Association

WITH different concentrations of ethyl alcohol in CCl_4 or CS_2, the variations in location and intensity of the bands near $3\,\mu$ have been investigated at various temperatures by J. Errera and his collaborators (*J. Chem. Phys.*, 8, 63 ; 1940). The band (3638 cm.$^{-1}$), due to single molecules, shows no alteration in intensity with concentration changes but increases in intensity at higher temperatures, whilst the band ($\simeq$ 3300 cm.$^{-1}$), due to polymeric molecules, increases in intensity with increased concentration and diminishes with increased temperature. With concentrated solutions (2–8 per cent C_2H_5OH), increased temperature causes a new band at 3520 cm.$^{-1}$ to appear, due to dimeric molecules. On the other hand, with dilute solutions ($<$ 1 per cent C_2H_5OH) practically no polymeric molecules are present and at high temperatures the dimerides break up to single molecules, and the spectrum shows diminution in the intensity of the dimeric band and increase in the intensity of the monomeric band. By cooling dilute solutions down to $-5°$ the band due to polymeric modifications reappears. At concentrations less than 0·12 per cent C_2H_5OH, only single molecules appear to exist. From the spectroscopic data the concentrations of the various species have been estimated. The mechanism involved in the association cannot be satisfactorily formulated ; nor can it be decided whether the association occurs as a result of electrostatic effects or from hydrogen bonding. The effect of adding acetone or pyridine to CCl_4 or dioxan solutions of C_2H_5OH has also been investigated. The spectra of these ternary mixtures exhibit bands due to single and double molecules, and to polymolecular complexes and addition compounds of C_2H_5OH with acetone or pyridine. The behaviour of solutions of HDO in D_2O and in various organic and inorganic media has been studied for the same spectral region.

The Electron Microscope at Toronto

THE electron microscope developed in the McLennan Laboratory at Toronto was described in the *Canadian Journal of Research* (A, **17**, 49 ; 1939). This paper contains a short and valuable summary of the results of other workers at the date of publication. The instrument is there described in some detail, and the problem of the steadiness of the high-tension supply is discussed. In this paper a limit of resolution of 200 A. was inferred. A more recent report on the microscope, by E. F. Burton, J. Hillier and A. Prebus (*Phys. Rev.*, 56, 1171 ; 1940), claims a resolving power of better than 60 A. This improvement is apparently largely due to the control of the illuminating beam of electrons, and the limit of resolution appears to be imposed to a large extent by the nature of the specimens rather than by instrumental factors.

A CENTURY IN THE FOREST LIFE OF NEW ZEALAND

One hundred years ago New Zealand had 63 million acres of forest; within eighty years it had been reduced to 12 million. Her woodlands had suffered the fate of those of so many other lands—they had been cut and mangled for immediate gain without any thought of the future. But unlike most lands where this had happened, the New Zealand people awoke to the danger of lost woodlands, and some thirty or forty years ago they decided to change their policy of total destruction for one of preservation and reconstruction. It came gradually, there being a period of overlapping with exploitation and replanting going on side by side. The policy to-day is wholly to preserve and replant.

New Zealand is in the fortunate position that not one part of her forests is inaccessible. The woods are within easy reach of shipping. This contributed in great measure to bring about exploitation, but this same feature will be of inestimable value when she comes to market her timber under a controlled policy.

For several years now the New Zealanders have led the world in the matter of tree-planting. In seven years alone 400,000 acres were planted. In one year 100,000 acres were planted, which is probably a record for the world. Altogether New Zealand possesses nearly a million acres of young forest.

What helped afforestation most in New Zealand was the discovery of the remarkable growth of certain introduced softwood trees. A pine which came from Monterey, California, namely, *Pinus insignis* or *radiata*, was the most remarkable of them all. This tree produces mature timber at 18–30 years of age and pulp wood at 12–14 years of age. The timber of mature trees is equal to the best Baltic pine, and has proved of immense value in making packing cases for dairy produce. It can also be pulped to make paper. One tree which was felled, aged forty-five years, fetched the very high price of £55.

Other trees which were introduced and reacted satisfactorily to the prevailing conditions were yellow pine, Oregon pine and the redwood of California. Certain poplars also have been making good growth.

The rapidity of growth attracted the attention of the business man. Companies were formed to afforest land and quick returns were obtained from the capital invested. Such a thing is almost unique in the history of forestry, timber growing being usually regarded as a State affair, since it means the locking up of capital for such a long time with very little return.

Within the last year or so the New Zealanders have again shown a great deal of wisdom by turning their attention to the trees which are native to the country. They are preserving what forests remain—8 million acres are under State control—and are trying to bring back to them their former grandeur and value.

The most famous natural tree of New Zealand is the kauri pine. Some remnants of it remain. This tree produced some of the best timber the world has ever seen. It also produced the kauri gum, great beds of which still lie in a fossil state in the soil. 15,000 tons of it are mined annually and find a ready market for making paint, varnish and linoleum. The resin from the living tree not only gives gum, but a motor-spirit is also being derived from it now.

There are other native trees such as yellow woods and the Nothofagus, the latter corresponding to the beech of Great Britain. The latter is now being tried on an experimental scale in Britain and is showing great promise. Then there is also the world-famous rimu tree. All these regenerate themselves naturally.

With such success already achieved it is little to be wondered that New Zealand is looking forward to the day when she will be a timber exporting country.

E. V. Laing.

INTERNATIONAL FISHERIES RESEARCH IN THE ATLANTIC*

The Committee of the Atlantic Continental Slope, on July 16, 1937, formed a sub-committee for the study of a technique concerning researches on the mackerel. Representatives from England, Ireland, France, Portugal and Germany were elected on the sub-committee, which met at the Plymouth Marine Laboratory during December 8–9, 1937. At this meeting discussions took place on: (1) the methods of sampling and selective action of nets; (2) biometrical data; (3) food; (4) age determination; (5) stages of sexual maturity; (6) plankton and hydrographical observations; (7) collection of early metamorphosed stages; (8) commercial statistics; (9) other researches.

Reports on the researches on the mackerel by J. le Gall and J. Furnestin (France), G. A. Steven and P. G. Corbin (England) and G. P. Farran (Ireland) show that progress has already been made along these lines. J. le Gall in France has been working on general and seasonal distribution, physico-chemical conditions, spawning, food and morphological characters. In Appendix I he gives a résumé of the known facts of the concentration before spawning, spawning periods and sexual maturity, growth and physical conditions of the environment. In Appendix II G. A. Steven and P. G. Corbin report on the work at Plymouth begun in 1936. Both French and English vessels participate in the spring drift fishery, from March until the middle of June, off the western entrance to the English Channel. The fish landed in the early part of the season are often thin, due apparently to absence of food supply.

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* Rapport Atlantique 1937–1938 (Travaux du Comité du Plateau continental Atlantique) (Atlantic Slope Committee) publié avec l'aide de Ed. le Danois, Dr.Sc. Directeur de l'Office des Pêches Maritimes, Paris. *Rapports et Procès-Verbaux des Réunions*, **111**, Conseil Permanent international pour l'Exploration de la Mer. Charlottenlund Slot, Danemark. 1939.

When food is available the stomachs are full and later, when zooplankton is plentiful, the mackerel feed voraciously upon this and still later, after the shoals have broken up and dispersed along the shores of the shallow coastal waters, they feed mainly on small fishes.

In 1937 a series of cruises was made in the area to the west of the mouth of the English Channel to try to obtain information concerning the spawning of the mackerel and dispersal and distribution of the young stages. Results from 1938 and 1939 are incorporated in the account. It was found that the spawning is a protracted one lasting from March until July or even August, with its maximum from mid-April to mid-May. It occurs within the area of the Continental shelf, not over great depths, but mainly well off-shore. From April until July there was a gradual eastward shifting of the locality of spawning accompanied by a diminution in the number of eggs. Later on there is found to be a similar eastward drift and decrease in numbers in the young stages. This change in locality with time is foreshadowed by the movements of the shoals which support the commercial drift fishery based on Newlyn from March to mid-June, although routine examination shows that scarcely any ripe or spent mackerel are landed on the fish market before about the end of May. It appears that fishing takes place not on the actual spawning centres but on the inner (landward) edges of them where the fish that have not yet spawned are located. The spawning period of the individuals is found to be a protracted one. The first indication of the spawning condition is the presence of ripe eggs which appear on the outside of the ovary, widely scattered among unripe eggs. Later these ripe eggs pass into the lumen of the ovary, which, externally, then reverts to an unripe appearance. The ripe eggs are shed and the process recurs, possibly many times, before the ovary is fully spent. For study of age and growth-rate it was found that the otoliths carefully prepared are of more value than the scales. Consequently this otolith method has been adopted. Preliminary work shows as yet no dominating year class. Examination of skeletons for racial characters, not yet fully worked out, indicates that the only variant that can be found—the numbers of the thoracic vertebræ with 'open' hæmal arches—shows some variation from sample to sample.

J. Furnestin in Appendix III shows results chiefly on hydrography and plankton from the entrance to the Channel and waters south of the Irish Sea, and G. P. Farran in Appendix IV deals mainly with the plankton as food for the mackerel.

Besides these researches on the mackerel there are reports by J. le Gall and J. Furnestin on the sardine, plaice, and sand eel, by Fen Hsüeh on Manx herring shoals, by P. Desbrosses on the John Dory and G. P. Farran on surface temperature observations at Coningbeg Lightship on the south coast of Ireland.

AUTOMATIC SERVICE OF LONG-DISTANCE TELEPHONE CALLS

FULL automatic service for toll or long-distance telephone connexions, as they are variously termed, has been in operation in a number of European countries for some years. The administrations and operating companies of countries which have not yet adopted this service are anxiously considering methods of improving their service and reducing its cost. An important paper by W. Hatton, the technical administrator of the Bell Telephone Manufacturing Company at Antwerp, is published in the January issue of *Electrical Communication*, a quarterly journal issued by the International Standard Electric Corporation of New York, U.S.A.

When converting telephone networks of national dimensions from manual to automatic operation, certain problems arise which can be dealt with in a purely technical manner, while others cannot be solved without due regard to the reaction of the telephone subscriber. Signalling over long-distance circuits by voice-frequency currents, automatic regulation of the transmission level and other technical features of long-distance service do not directly concern the subscriber, provided that the final result is satisfactory. The manner in which charges for long-distance service are established and the form in which the monthly or quarterly account is presented are matters which have both technical and administrative aspects, and in which the subscriber is keenly interested.

To operate long-distance service on an automatic basis, calls must be charged automatically, and the method adopted for this must give complete satisfaction to the subscriber. Prior to the introduction of a system of automatic ticketing, first applied in Belgium, there appeared to be no method of charging subscribers automatically for their long-distance connexions, except by means of the message register. This 'message' method, known to the telephone world as 'time or zone' or sometimes as 'multiple metering', has its disadvantages. A summary of these disadvantages shows that some of them are serious and that business organizations would be reluctant to accept a monthly or quarterly bill without particulars of the individual charges for each of their long-distance connexions. In the case of hotels, these particulars would in most cases need to be furnished immediately on demand. The real solution would have to be one which maintains the present situation between the charges for local and long-distance tariffs (allowing each to be developed to suit their separate requirements) and which at the same time provides a record giving the date, the time of day, the duration of call and the cost of the message, preferably printed on a ticket.

From the practical point of view the design of such a system of automatic ticketing must permit of its introduction to existing exchanges with the minimum of modification to the equipment already installed and in operation. The author gives a sketch of such a system in operation in Belgium which seems to be in every way satisfactory. Although this system is quite a recent invention, there are already installed or on order 150,000 lines.

An excellent description is given by Mr. Hatton of the problems that had to be faced in designing an automatic ticketing system in three areas in Belgium, namely, Brussels, Antwerp and Malines. The urban network of Brussels contains fifteen exchanges of the rotary type, some dating back to 1922. The normal capacity is 115,000 lines, and this network furnishes a good example of the manner in which automatic ticketing can be added to existing equipments. The author states that Antwerp, Liége, Charleroi and other Belgian towns will follow the method adopted for Brussels.

The first installation of automatic ticketing was put into service in Bruges in 1936, and was rapidly followed by installations in Ostend and twelve other towns in Belgium. During the period July 1–September 15, 1937, a check of 62,000 ticketed calls revealed 80 tickets, or 0·13 per cent, bearing incomplete or incorrect details, and these results go far to prove that full-automatic methods can be applied to long-distance service with the same success as to local service.

The tickets provide the traffic department with valuable information, and also give a remarkably clear picture of the operating efficiency of the exchange. Each long-distance call is recorded whether it be an effective connexion or whether it results in "busy", "no answer", "wrong number", or "premature release". Equipment faults which might otherwise remain unsuspected and undetected are brought to light by the indisputable evidence of the ticket. Naturally, further developments in this field are to be anticipated. It may prove advantageous to use a small number of high-speed printers which are engaged only at the termination of a call.

A form of ticket may be produced which can be automatically sorted, and, ultimately, doubtless mechanized-accounting will further dispense with the need for human intervention. Finally, it is anticipated that automatic ticketing will prove immensely valuable in Europe when the development of international long-distance service on a fully automatic basis becomes possible.

ANALYSIS OF FIELD TRIALS

Variety testing forms an essential part of the work of the plant breeder and so he needs an adequate technique for the design and statistical analysis of field trials. His requirements in this direction are, however, rather specialized, the prime necessity being a method of comparing a large number of selected lines, though the careful testing of a small number of valuable new strains against standard varieties is also of importance.

Now one of the greatest advances made by modern statistics has been to revolutionize field trial technique. Until recently, however, the development of field designs was largely concerned with manurial and other such trials, where a limited number of treatments are applied and where interactions of these treatments are detectable and potentially of interest. Furthermore, when it was shown that multiple interactions are seldom if ever significant, a new technique, that of confounding, became possible. A design involving confounding purposely sacrifices information on less important interactions, in order to make the main comparisons with more precision.

Clearly all field trials must be based on the same principles as these 'treatment' designs; but the latter in themselves are not fully suited to the plant breeder's work. He often requires to work with large numbers of varieties and has no uninteresting 'interaction' comparisons which may be sacrificed by simple confounding. His requirements have, however, recently received special attention, and appropriate lay-outs have been developed. For example, the quasi-factorial designs, involving a somewhat complicated application of confounding, meet the needs of the plant-breeder admirably but are in general of small value to those interested in soil treatment.

Thus it is very appropriate that the Imperial Bureau of Plant Breeding and Genetics should publish a technical communication on the subject of field trials, by an author who has been associated for many years with this branch of statistical work*. The publication is essentially introductory in scope, and the contents have been admirably chosen to fulfil this purpose. The first sections deal with the general principles of yield determination and the measurement of experimental error. Then follow descriptions of the randomized block and Latin square designs, together with details of their numerical analysis. The discussion of the use of the Latin square well illustrates the considerations involved in the choice of a design appropriate to an experiment. Multiple factor experiments are next dealt with and the principles of orthogonality and confounding introduced by a simple example. Finally, the split plot technique, which is especially suited to combined variety and manurial trials, and the quasi-factorial designs are briefly considered. The latter is somewhat complex for introduction into an elementary account, but its inclusion is amply justified by its pre-eminent position among layouts for testing a large number of varieties.

The presentation of the material is adequate, though more open to criticism than is the choice of contents, in that it tends at times to be too technical. For example, the introduction of the terms 'self-conjugate' and 'transformation set' into the section on Latin squares is unnecessary as their meanings are not explained, the reader being referred elsewhere for an account of their use. Thus they do not materially aid the argument and are somewhat terrifying to the beginner. The discussion of the *t* test in the third section could also be made much more real for the biologist by the use of actual experimental data as illustrative matter, rather than the very artificial example of two varieties with unequal means but exactly equal variances, which is in fact used.

There can, however, be no doubt that plant breeders will find this publication a helpful introduction to the subject of field trials. Nor will its use end there, as the list of more advanced works given, together with short notes on their contents, in the last section, will serve as a guide for later reading and reference. K. Mather.

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* Field Trials: Their Lay-out and Statistical Analysis. By John Wishart. (Imperial Bureau of Plant Breeding and Genetics, Cambridge.)

SEVENTY YEARS AGO

NATURE, Vol. 2, June 16, 1870

Scientific Education of Women

"The feature which will probably most clearly mark the year 1869 in the view of the future historian of Education, will be the definite recognition of the rights of women to all the advantages of education accorded to men." This is the opening sentence of an article surveying the position. Reference is made to courses of lectures on physiography, physics and botany given by Huxley, Guthrie and Oliver at South Kensington, and to other courses in London, at Edinburgh, Manchester and Liverpool. The results of examinations based on these courses show that "not only can women compete with men in the qualities essential for severe and successful study, but that in many respects their average attainments are higher than among the working members of a University". The work of the Edinburgh Association, all the teachers of which are professors of the University of Edinburgh, is thought to derive much benefit from its connexion with the University.

As regards medical education, the exclusion of women is considered to be due to the fact that "the teachers and practisers of medicine and surgery form a guild, a professional trades' union, protected and licensed by the Government", who are acting in self-defence.

Circumlocution

A provincial druggist [in France] desirous of gathering fox-glove (*Digitalis*) in one of the State forests, applied for permission to the local authority (*garde général local*), offering at the same time to pay an annual sum of six francs for the privilege. The local magnate transmitted the request to his inspector, who forwarded it to the Conservator of the department, who dispatched it to Paris to the Director-General of Forests, who caused it to be sent to the Minister of Finance. The Minister referred to "for study" to the Director-General of Domains, who sent it to the Departmental Director of Domains to be examined by the Registrar. The latter, after examination, pronounced a favourable opinion on the request, and sent it back to the Departmental Director, who forwarded it to the General Director, who, in his turn, dispatched it to the Minister, through the agency of the General Secretary of Finance, who availed himself of the opportunity to make his comments on the matter. Then the unhappy druggist's request was returned to the Director-General of Forests, who sent it to the Conservator, he to the inspector, and the inspector to the *garde général*, who was the original recipient of the request. The authority "to cull simples", at length reached the successor of the original postulant, and at an age when he was too old to herborize.

Well-wishers of the University of Oxford will rejoice to hear that the honorary degree of D.C.L. has been offered to Mr. Darwin. The state of Mr. Darwin's health unfortunately precludes him from accepting the proffered honour, but the scientific naturalists of this and other countries will not the less appreciate the compliment which has been paid to their great leader. It is all the more graceful as Mr. Darwin is not an Oxford, but a Cambridge man, a circumstance which the University of Cambridge seems to have forgotten.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Tuesday, June 18

Austrian Academy in Great Britain, at 5 p.m.—Prof. Dr. F. A. Hayek: "The Austrian School of Economics".

Thursday, June 20

Chadwick Lecture (at the Chelsea Physic Garden, Swan Walk, S.W.3), at 4 p.m.—Prof. William Brown, F.R.S.: "Plant Disease in Relation to the Public".*

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Graduate Mistress to teach Mathematics in the English High School for Girls, Istanbul—The British Council, 3 Hanover Street, W.1 (quoting 'Istanbul') (June 17).

Assistant Education Officer—The Chief Education Officer, County Hall, Kingston-upon-Thames (June 19).

Organizer of Agricultural Education for the County of Suffolk—The Secretary, County Education Committee, Education Office, County Hall, Ipswich (June 21).

General Manager of the Rivers Department—The Town Clerk, Town Hall, Manchester 2 (June 22).

Assistant to teach Engineering Science, Engineering Drawing, etc.—The Registrar, Wimbledon Technical College, Gladstone Road, S.W.19 (June 24).

Graduate Assistant Mistress to teach Mathematics and General Form subjects in the Hong-Kong Education Department—The Secretary (I.P.C./C.A.), Board of Education, Alexandra House, Kingsway, W.C.2 (June 24).

Assistant Lecturer in Naval Architecture—The Registrar, The University, Liverpool (June 24).

Technical Assistant to the Executive Officer—The Executive Officer, Rutland War Agricultural Executive Committee, Catmose, Oakham, Rutland (June 25).

Student-Demonstrator in Botany—The Principal, Royal Holloway College, Englefield Green, Surrey (June 29).

Head of the Department of Horticulture—The Secretary, West of Scotland Agricultural College, 6, Blythswood Square, Glasgow (June 29).

Principal of the proposed Technical Institute at Delhi—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (quoting Appointment 1/11G) (June 29).

Professor of Chemistry at Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

Draughtsmen Grade I (Ref. No. A.506) and Draughtsmen Grade II (Ref. No. A.507) at South Farnborough, and Draughtsmen Grade II (Ref. No. A.508) at Gosport—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting appropriate Ref. No.).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

The Eggs of British Birds. By Colin Matheson. Pp. 26+2 plates. (Cardiff: National Museum of Wales.) 4*d*. [275

Government of Transjordan. Report on the Water Resources of Transjordan and their Development. By M. G. Ionides. Incorporating a Report on Geology, Soils and Minerals and Hydro-Geological Correlations, by G. S. Blake. (Published on behalf of the Government of Transjordan.) Pp. xxiii+372. (London: The Crown Agents for the Colonies.) 30*s*. [275

Jealott's Hill Research Station. Bulletin No. 1: The Teart Pastures of Somerset; Cause of Teartness and its Prevention. By W. S. Ferguson, A. H. Lewis and S. J. Watson. Pp. 28. (Bracknell: Jealott's Hill Research Station.) [285

Patents, Designs and Trade Marks. Fifty-seventh Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1939. Pp. 26. (London: H.M. Stationery Office.) 6*d*. net. [285

Other Countries

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 29, Memoir No. 1: Jurassic Plants from Afghan-Turkistan. By Rajendra Varma Sitholey. Pp. iv+25+8 plates. (Calcutta: Geological Survey of India.) 4·2 rupees; 6*s*. 6*d*. [295

Journal of the Indian Institute of Science. Vol. 23A, Part 1: Changes in the Carotene and Ascorbic Acid Content of Mangoes during Ripening. By G. B. Ramasarma and B. N. Banerjee. Pp. 10. (Bangalore: Indian Institute of Science.) 14 annas. [295

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INTERNATIONAL DEMOCRATIC UNITY

A DECLARATION of Union offered by the British Government was handed to the French Government by His Majesty's Ambassador on June 16. It is not necessary to reproduce here the complete Declaration, though a few phrases may well be emphasized.

> "The two Governments declare that France and Great Britain shall no longer be two nations but one Franco-British Union. The constitution of the Union will provide for joint organs of defence, foreign, financial, and economic policies. . . . During the war there shall be a single war Cabinet, and all forces of Britain and France, whether on land, sea, or in the air, will be placed under its direction. . . . The Union appeals to the United States to fortify the economic resources of the Allies and to bring her powerful material aid to the common cause."

At the time of writing it is impossible to indicate French reaction to this great and valuable gesture of the British Government, neither is it possible at present to speculate on its implications or results. But men of science might well view with pride this political move as following very closely what has been going on in the world of science over a period of many years. Scientific collaboration has gradually been getting more intimate—a fact which will be apparent from an examination of the pages of the last score or so of volumes of NATURE. But such scientific collaboration was not confined to the democracies. Until comparatively recently, communications to the Editors arrived from all countries where scientific research was being pursued, that is, all civilized countries. It is true that, in the few years preceding this War, communications from the Totalitarian States, especially Germany, had been reduced almost to nil, whereas from the Democratic Powers and smaller Democracies, and especially from the U.S.S.R., there has been a decided increase.

In the Declaration, it is suggested that the "two Parliaments will be formally associated". International scientific parliaments in the form of congresses, conferences, symposia, etc., had already, until the outbreak of war, been more and more frequent and comprehensive.

But by the intensification of totalitarian policy, international scientific policy has been adversely affected. On several occasions international conferences have been postponed or cancelled. This has had the effect of forcing men of science of democratic, free countries into closer collaboration. Contact between British and American men of science has become more intimate during the past two or three years, as exemplified in many ways such as the closer relation between the British and American Associations for the Advancement of Science marked by the inauguration of the British and American Association Lecture in 1938. In present circumstances, we hope that British and American collaboration will not only continue but also become intensified.

Collaboration between the British and French Associations was developing before the outbreak of war; but shortly after the start of hostilities, important moves were made to bring the men of science of these two great democracies into even closer union. We may now disclose the fact that a strong group of French scientific workers were inquiring into the possibility of publishing periodically in NATURE articles contributed by French men of science in the French language—a suggestion which was viewed favourably by the Editors. Whether such a scheme will now prove feasible remains to be seen.

But a comprehensive scheme for collaboration by means of the centralization of scientific knowledge was already developed by a French group in the early stages of the War, and its machinery set working at the beginning of this year. Faced with an output of research papers running into millions, the recording of existing knowledge is a problem as important and difficult as any connected with science. For this reason, a Service de Documentation, under the direction of Prof. Pierre Auger, was established by the French Government's Centre National de la Recherche Scientifique.

The Service de Documentation has begun the issue of a *Bulletin Analytique**, which contains the titles or very short abstracts of papers published in the chief journals of chemistry, physics, applied chemistry, technical physics, biochemistry, and some branches of biology (see also p. 965). It is hoped to publish the *Bulletin* in fortnightly parts, with quickness of publication as a particular aim, and to publish every abstract within a month of its preparation. This speed is obtained by brevity and good organization. The *Bulletin Analytique* is intended mainly to aid the specialist.

The Service has also organized an archive of original papers. It also offers to file a copy of any typescript paper acceptable to it, and include an abstract in the *Bulletin.* Such abstracts are given a special mark. Copies of the deposited typescript can be made by machine, and supplied to applicants.

Extensive use is to be made of microfilms. Negatives will be made of any paper abstracted in the *Bulletin,* and positives supplied to research workers in laboratories and institutes. The cost of these positives is astonishingly low. A strip of film bearing images of ten pages of a paper costs about one penny. Films of very long papers and typescripts containing large numbers of illustrations cost a few pence. The images on the film are 18 mm. × 24 mm. in size, and when magnified ten times make a page of normal size. The images of the pages may be read through a small eyepiece costing about 7*s.* 6*d.*, or they may be projected in page size on to a horizontal screen by a simple projector which costs less than £3. A third instrument at an intermediate price has also been devised.

Bibliographies of special subjects are made by assembling sections of microfilm. The sections are 19 cm. long and contain images of ten pages. They are placed in a file 20 cm. in size. One file will hold a substantial bibliography, and a drawer of files can contain microfilms of thousands of original papers.

The head office of the Service was established in the rue Pierre Curie, Paris, but we trust that arrangements have been made for it to function elsewhere now that Paris is in enemy hands. Some of the chief members of the staff have been associated with the "Tables Annuelles", and they are assisted by about forty abstractors and translators. Besides preparing the *Bulletin* and supplying microfilms of desired papers, the staff undertake on request the preparation of indexes and dossiers on particular subjects. They also prepare translations of papers in the less widely known languages.

The Service is at present limited to France, Great Britain and their Dominions and Colonies. It has already received valuable aid from the Science Library in London. This is the type of collaboration between British and French institutions which should be extended and, above all, made permanent and extended to those of other countries.

One of the most interesting features of the Service is that it has been organized by an experimental physicist. It provides evidence of the administrative ability dormant among young men of science. The scientific worker has the great advantage as an administrator in his own field of knowing exactly what he is dealing with, and what he wants, and he can accordingly devise the most efficient organization for providing it. The non-scientific administrator, with the utmost good will, frequently fails to grasp the possibilities in scientific matters, and does not understand how to create the conditions in which science can be used most effectively.

The establishment of the Service de Documentation for the aid of scientific workers both in France and Great Britain emphasizes once more the need for improving communications between democratic countries, so that the best co-operative use can be made of their national institutions.

It is not possible at the time of writing to get in touch with Prof. Auger, and therefore we cannot know the present plight of this Service, which augured so well for the contribution of science to international democratic unity. Much less is it possible to foretell the immediate future of British and French scientific collaboration; though of the ultimate future there can be no doubt.

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* *Bulletin Analytique,* 1, Nos. 1–6, Janvier-Mars, and Nos. 7–8, Avril, 1940. (Hermann et Cie.)

CAMOUFLAGE IN MODERN WARFARE

AT times like the present, when the threat of aerial bombardment and the possibility of invasion broods over Great Britain, public interest is naturally aroused in the subject of camouflage and its role in modern warfare. In happier and more normal times camouflage has been of interest primarily to the naturalist, who sees in the coloration of different wild animals a variety of devices which render them extraordinarily difficult to detect in the field. The underlying optical principles which govern visual concealment and deception are biological principles, the discovery and description of which are mainly due to the observations of naturalists and sportsmen. These men, whose labour or leisure has brought them into intimate contact with wild creatures, claim no particular credit for their discoveries, which are essentially an exposition of principles beautifully demonstrated by Nature herself.

The general application of these principles for war purposes was first suggested to a Government Department by Prof. (now Sir John) Graham Kerr, who in September 1914 communicated to the First Lord of the Admiralty methods of rendering ships at sea less easily recognized—in particular, by means of countershading, and disruptive coloration or 'dazzle' as it was called later. More recently the problem of camouflage has been intensely studied by Dr. Hugh B. Cott, whose lecture to officers at Chatham (*Royal Engineers Journal*; Dec., 1938) summarized a subject which he has dealt with more fully in an important work on "Adaptive Coloration in Animals" just published*. Well-defined principles of camouflage, derived from research in biology and psychology, are now established ; but authorities in the various Service Departments concerned have been slow to make the most of this available knowledge. Indeed, the history of war camouflage provides an extraordinarily convincing example of the ineptitude of the existing system where science is concerned.

In reply to a question by Mr. S. F. Markham, Sir John Anderson stated in the House of Commons on August 2, 1939, that he did not propose, "as at present advised", to attach a biologist to the Camouflage Research Station. He had, however, invited a biologist to serve on an Advisory Committee to which he proposed to refer questions of scientific principle affecting camouflage. After an interval of eleven weeks from its constitution, this Committee was summoned to meet for the first time on October 18, 1939. During its subsequent brief history, the scientific experts serving on this panel were kept to a great extent in ignorance of the camouflage policy and programme operating in the Service Departments ; co-operation between the different departments and even within individual departments was lacking ; insufficient attention was paid to research and to the advice of members of the panel ; and there was evidence of slackness and lack of initiative and interest by officials concerned on the executive side. Before the end of March of this year, the chairman, and the two members of the committee possessing the requisite scientific and practical qualifications, had resigned or expressed their desire to resign.

On April 18 last, the Secretary of State for the Home Department announced that after examining the question of camouflage in the light of the experience gained since the beginning of the War, he proposed some reconstruction of the present organization of this work in reference to war needs. In due course the advisory committee, now termed the Camouflage Committee, was reconstituted under a new chairman, so as to include, among others, responsible representatives of those branches of the three Service Departments and the Ministry of Supply which are concerned with camouflage work. It was hoped that these changes would result in greater co-ordination and more effective pooling of information. Such hopes have, however, proved groundless : we are informed that the Camouflage Committee has not yet held its first meeting.

An illuminating commentary upon the lack of progress—remarkable even for a Government Department in these stirring times—and upon the failure to make proper use of those best qualified to serve in this field, is provided by a question and reply given in the House of Commons so recently as June 5 last, when Sir John Graham Kerr asked the Home Secretary whether he was aware that the establishment of the scientific principles which determine the effectiveness of camouflage was the work of biological specialists in this subject ; that one of the leading authorities in this specialized branch of science was a British subject; and whether steps had been or would be taken to ensure that his full-time services should be available to the country during the present emergency. The following reply was made by Sir John Anderson:

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* Adaptive Coloration in Animals. By Dr. Hugh B. Cott. Pp. xxxii+508+49 plates. (London: Methuen and Co., Ltd., 1940.) 40*s*. net.

"I am aware that biological science has made an important contribution to the study of camouflage, and I have invited a British biologist to serve on the Camouflage Committee. He has accepted my invitation and will, I have no doubt, be ready to give to the matter as much of his time as may be required."

We believe that the Committee concerned has never met, so it would scarcely appear that the best possible use is being made of this biologist's knowledge and experience.

When we turn to the personnel engaged at the Civil Defence Camouflage Establishment, the prospect is scarcely reassuring. Of some sixty-five technical officers, all but four are either professional artists or, at the time of recruitment, were students at art schools. Not one member of the establishment is a qualified biologist. It appears, moreover, that none has attended a course in the science of camouflage, and indeed at the present time there does not exist any such course of instruction which they could attend.

When the fact is realized that camouflage research and application are at the present time largely dominated by artists, or in the hands of Civil Servants and Army officers, and in either case controlled by people lacking the necessary scientific training and with no knowledge of the fundamental biological and psychological principles involved, the failure to achieve effectiveness which one sees on every side is rather to be expected than wondered at. But it is not less deplorable on that account.

The general lack of appreciation of the scientific background of camouflage has led to the neglect, or misapplication, of such basic principles as countershading, disruption, coincident pattern and deflection. As a result, much contemporary effort at camouflage has failed utterly and is consistently failing to attain effectiveness.

A serious fallacy—though one which need cause little surprise when we remember the artistic qualifications of those concerned—is seen in the excessive reliance placed upon paint, as opposed to structural camouflage. Only rarely is pigment able to counteract the effects of light and shade, and of cast shadow, presented by vehicles, buildings and other solid bodies in the open. Still less is paint of value when it is put on, as it is being put on everywhere at present, in defiance of the well-established scientific principles of countershading and disruption.

An efficient way of rendering a solid object easily recognizable is to paint it all one colour. Continuity of surface, unbroken outline, and relief will then reveal to the eye its true nature without the interference of illusion or distraction. Now the type of camouflage seen, for example, on Service vehicles displays a ludicrous attempt at disruption which fails entirely since the colours used are of approximately equal tone. Mere differences in tint become invisible at a short range, and objects so coloured are virtually self-coloured and hence self-evident.

Another common misapplication of paint, again unfortunately understandable in an artist used to thinking in terms of pictorial representation, is seen in the attempt to camouflage large structures such as hangars with representations of trees done in paint. An extravagant example of this foolishness was the decoration of the cooling towers of a large works to represent a grove of tall trees. It should scarcely be necessary to point out that the result of light and shade is such as absolutely to kill this piece of stage scenery at bombing range. Such exhibitions are the more to be regretted since they tend to bring down ridicule upon the art of scientific camouflage.

The principle of countershading, whereby the appearance of relief (upon which the visual interpretation of form and solidity so largely depends) is obliterated, has an obvious application to all kinds of objects of importance in war—tanks, torpedo-tubes, guns, aircraft, and buildings. Indeed, in principle, all camouflage by mere paint should be worked out on a basis of countershading. But Thayer's principle is still ignored by the authorities in the Service Departments. Even the simplest case, that of a gun, has been consistently bungled, frequently by being divided into an upper dark and a lower light half, without any attempt at gradation between the two, a method which shows that the basic principle of obliterative shading has never been grasped by the authorities concerned. A glaring example of incompetence was a recent photograph in the daily Press showing a coastal defence gun painted in a manner which nullifies Thayer's principle. The same remark applies to the vast majority of 'camouflaged' Service vehicles on the roads to-day.

A hard case of official ignorance is presented by the use of cryptic paint on bus-tops. The roofs of many double-decked buses now have been treated with grey or green and brown ; but the front, back and sides—the parts most visible in oblique view from the air—are coloured a brilliant red—the very hue the chief attribute of which is its carrying power and conspicuousness. Similarly many buildings have the roof camouflaged and the side walls neglected.

When we turn to camouflage at sea, we find that by a reversal of evolution, disruption (or 'dazzle'), used with success towards the end of the War of 1914-18, has now been abandoned ; and abandoned because of its supposed unsuitability in view of the fact that ships are seen against constantly changing backgrounds of sea and sky. It is scarcely necessary to mention here that this fact is, of course, the very reason why disruption, rather than self-coloration as at present, should be used as the only effective way of hindering recognition at sea.

So long as the present unsatisfactory state of affairs lasts, injury will continue to be done to the nation's war effort. The matter is urgent. Camouflage is destined to play a great part in the struggle. To those who have only given the matter hasty thought, the problem of visual concealment may appear in a minor role. Biologists and others who fully realize its scope and possibilities take a very different view ; and among those who know most there is a growing sense of uneasiness. At no time in our history has camouflage been of such vital importance as it is to-day. Yet under the present system, the men who know best what should be done seem to be excluded from getting anything done. Unless, and until, the fundamental biological principles are understood and applied by the authorities, attempts at camouflage are merely ridiculous. Now, after all these months of muddling and waste, and at this eleventh hour, the Government Departments concerned—Navy, Army, Air and Civil—must be urged in the strongest possible manner to take up the question of camouflage seriously and to tackle it scientifically.

PROF. FRANZ BOAS

Race, Language and Culture

By Franz Boas. Pp. xx+647. (New York: The Macmillan Company, 1940.) 21*s.* net.

IN this volume Prof. Franz Boas, the doyen of anthropologists of the United States, has reprinted a selection of his briefer but not, therefore, less weighty contributions to anthropology in the course of his long career. The earliest is dated 1887, and deals characteristically with the methods and subject-matter of geography, more especially in its humanistic aspect. The essays are classified, as the title indicates, under three heads ; and the order is logical rather than chronological. This order is the more appropriate in that while naturally as knowledge and experience have grown they have brought with them clearer insight into the processes and possibilities of the science, yet from the very beginning Prof. Boas has been singularly consistent in his methods of approach to certain aspects of the study of man.

Throughout his career, but more especially in his later work, Prof. Boas has held fast to the conception, not so common in his earlier days, that the results of anthropological investigation are not merely concerned with the backward and primitive, but are applicable to the needs and problems of modern civilized communities. Hence in dealing, for example, with problems of race, he is not content to examine and analyse physical measurements as the sole basis of investigation, though allotting them their due share of significance, but envisages the sum total of the conditions, environment, psychological, social and the like, bearing upon the problem under consideration. In this respect he stands alone, without rival.

In this collection of reprinted pieces, representative examples will be found of much of the most original and lasting contribution by Prof. Boas to anthropological thought in general and the anthropology of the American continent. Here is his report on studies in the changes in bodily form of the descendants of immigrants, which has been the source of much controversy, as well as "Race and Progress", the presidential address to the American Association for the Advancement of Science in 1931, in which he challenged Sir Arthur Keith's dictum that racial antipathy was implanted in man by Nature in the interests of natural selection. In view of the causes underlying the present European conflict, and the population problems of the American continent, these studies are of both topical and abiding interest.

In the section dealing with cultural subjects are several papers which touch upon the culture of the Kwakiutl and other peoples of the North-West Coast. Prof. Boas has long been devoted to the study of this region, which has bulked large in the development of the American historical school of anthropologists, of which he is rightly regarded as the founder. In addition, he has also included some of his important contributions to the study of development of primitive art, which at the time of their first publication in 1903 and 1908 were little short of revolutionary in their effect upon the approach to the study of conventional design.

THE PRINCIPLES OF DEVELOPMENT

(1) Principles of Development

A Text in Experimental Embryology. By Paul Weiss. Pp. xx + 601. (New York: Henry Holt and Co., 1939.) 5 dollars.

(2) Les progrès récents de l'embryologie expérimentale

Par Prof. Maurice Caullery. (Bibliothèque de philosophie scientifique.) Pp. 236. (Paris: Ernest Flammarion, 1939.) 22 francs.

(1) PAUL WEISS'S "Principles of Development" is one of the most complete accounts of experimental morphogenesis to appear in recent years, and certainly deserves a welcome in a field not too well provided with general texts. It attempts to combine a text-book with a critical discussion of the theoretical principles on which our interpretation of developmental phenomena is based. The hybrid is a vigorous animal and will give any reader a good run for his money, in spite of the fact that while its main body is galloping rapidly forwards its intelligence is hampered by a nostalgia for yesterday's metaphysics.

As a text-book it contains several brilliant innovations. The introductory inventory of development, with its discussion of growth and of the gradual differentiation of cell-strains; the discussion of the methodology of embryological research; and the account of the development of the nervous system and behaviour, with its implicit admission that development is one of the dimensions of all biological phenomena, characterizing physiological functioning just as much as anatomical structure; all these sections are exceedingly well done. It is only in the middle section, where the emphasis is dictated by the type of analysis adopted, that doubts arise.

Even in this part it is only rarely that the theoretical weaknesses have led to actual mistakes, although one must regret the uncritical acceptance of the isolation experiments on the chick as providing evidence about the properties of the germ as a whole rather than of the organizer; nor is there any justification for omitting any reference to the existence, let alone the functions, of the endoderm. The important criticism is that Weiss seems to mistrust most of the analytical concepts to which causal significance can be attached. This is most obvious in the case of genes, which are dismissed with a footnote reference to text-books of genetics. But in the discussion of the organizer, which is at present the central principle of developmental mechanics, although Weiss follows the English school in making a distinction between the properties of producing an inducing stimulus and of controlling the arrangement of the resulting tissues, he is unwilling to pursue this line of thought beyond the comparatively superficial aspects of the phenomena. Thus he deals most inadequately with the connexion between morphogenesis and metabolism, and in this way underemphasizes a line of work which is being actively pursued by biochemists at the present day, and is perhaps the most likely to bring developmental phenomena into closer relations with the rest of experimental biology. On the other hand, the book contains a fine discussion of one of the other promising lines of causal analysis, namely the influence of fine-structures at the liquid crystal level. This is a field in which Weiss has himself made some of the most notable contributions, and his evaluation of it is excellent.

Weiss formulates development largely in 'field' terms; a process such as the formation of the neural plate is for him a resultant of "field pattern" and "field energy". He gives an admirable analysis of the field concept, for the introduction of which into embryology he was largely responsible. In this analysis he makes it quite clear that the field is a descriptive convenience, not a causal agent. But can one then be content to formulate an experimental science in purely descriptive terms?

(2) Prof. Caullery's little book is a straightforward account of recent work in experimental embryology. There is no need to discuss its theoretical basis, since it does not attempt to penetrate beneath the

generally accepted ideas. It provides a short, clear and remarkably complete summary of the newer developments, and is, an agreeable surprise in a French book, adequately illustrated, though it still suffers from the poverty of index which is another unfortunate national characteristic. If available, it should have a wide sale in Great Britain, since it is both cheaper than any other comparable text-book, and also provides the student with the essential information in a much shorter space than any of its competitors.

C. H. WADDINGTON.

REGIONAL GEOLOGY OF THE EARTH

Regionale Geologie der Erde
Herausgegeben von K. Andrée, H. A. Brouwer und W. H. Bucher. Band 2: Palæozoische Tafeln und Gebirge. Abschnitt 2: Northwestern Europe Caledonides. By Prof. E. B. Bailey and Prof. Dr. O. Holtedahl. Pp. 84 + 2 plates. 14 gold marks. Abschnitt 3: Mittel- und Westeuropa. Von Prof. Dr. Hans Becker. Pp. 114. 14 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.)

IN this new "Regional Geology of the Earth", of which two parts are noticed here, there is to be presented a summary of the geological history of the earth's surface in which emphasis is placed more on tectonic and magmatic events than on details of stratigraphy. The division into regions for description is based upon tectonic history but, at the cost of some overlapping, complete geological accounts are to be given of each region. The work is intended for the trained geologist, and attention is therefore to be directed as much to unsolved problems as to criticism of materials already assembled.

The complete work is projected to consist of three volumes, the first dealing with the Ancient Coigns, the second with the Palæozoic Plateaulands and Folded Belts, the third with the Later Orogenic Belts. The two parts considered here belong to volume 2, and are concerned respectively with the Caledonian and Variscan mountain-building in Western Europe.

(1) The first part provides a summary of the geological history of the Caledonian fringe of north-west Europe. It deals with the margins, contents and fate of the Lower Palæozoic geosyncline which stretched from Spitsbergen through Norway into the British Isles. Prof. O. Holtedahl is responsible for the sections dealing with the Spitsbergen and Scandinavian portion of the geosyncline, and Dr. Bailey for the British portion.

For British readers, Holtedahl's account of a modern Scandinavian view is of particular importance. He supplies two plates of great value. The first of these is a correlation of the sedimentary series belonging to the Caledonian cycle in the Arctic and Scandinavia, the second a geological map of the Scandinavian Caledonian zone on a scale of about 1 in 250,000. Amongst a multitude of interesting topics, two may be cited, namely, the importance of Eocambrian (Sparagmite) in the Caledonian zone, and the genetic connexion between high-grade metamorphism and Caledonian igneous activity.

Bailey's treatment of the British Isles is a marvel of compression, as it provides within some 30 pages a summary of British geological history from Lewisian to Pleistocene. This summary is embellished with excellent, if schematic, maps of Scotland, Ireland and North England and Wales. In so short an account it is necessary for the author to take sides in many controversial questions, but this is done fairly, especially in connexion with differences of opinion on Highland problems. Holtedahl's views on the importance of the sparagmite in Norway and on the Caledonian age of the metamorphism there are echoed by Bailey for Scotland, in that he suggests that the Dalradian may be sparagmite, and the Highland metamorphism Ordovician in age. These suggestions will be of great interest to Scottish geologists, who will doubtless reflect upon them.

References to literature are merely skeletal and there is no index—perhaps this latter is not needed for a 75-page account.

(2) Prof. Hans Becker deals with the Variscan and Saxon tectonics of Western Europe. He gives a summary of the pre-Variscan elements, the Variscan folds, Palæozoic magmatic history and the folding of Saxon style, and carries the geological history up to the present day. Whether one admits or not the justification of so compressed a summary as Becker gives, one is nevertheless rewarded by the last half-dozen pages of this part. Here brief mention is made of a series of interesting topics—the Variscan magmatic cycle, the meagreness of the Variscan geosyncline, the consequences of this and the source of the geosynclinal fill, some general criticism of the geosynclinal-orogenic doctrine, peculiarities of the movements of Saxon style, and so forth. One could wish that these topics had been made texts for the whole sermon.

H. H. READ.

THERMODYNAMICS AND THE LOWEST TEMPERATURES*

By Dr. C. G. Darwin, F.R.S.,
Director, National Physical Laboratory

Equipartition of Energy

THE subject of thermodynamics goes, of course, beyond the familiar principles of ordinary dynamics, and it is therefore natural that we must have an extra principle in order to be able to work it. This principle which I am going to use is the *equipartition of energy*. Suppose that we have a closed vessel containing a gas, say, oxygen. If we imagine that we knew the motion of all the molecules at some instant of time we could work out their kinetic energies, and adding them together we should have the total energy of the gas in the vessel; a perfect gas has no potential energy, and oxygen is nearly perfect. We could divide this total by the total number of molecules, and so get the average energy of a molecule. Moreover, since the collisions do not change the energy, the average will be constant as the time goes on. Now suppose that we take two gases together, mixing, say, hydrogen with the oxygen. The atoms of the two kinds can now collide with one another and interchange energy, and the question arises of what happens. The theorem of the equipartition of energy tells us the answer. It asserts that the average energy of a hydrogen molecule will be equal to that of an oxygen, and this no matter what the proportions of the two gases that may be mixed together. Since energy is proportional to the square of speed, and the oxygen molecule is sixteen times as heavy as the hydrogen, it follows that the hydrogen molecules are on the average moving four times as fast as the oxygen.

This is the simplest example of the theorem, simplest because we have taken perfect gases. But it is true in other cases, so that any part of any system that is capable of exchanging energy will take a share of the energy, and on the average will have exactly the same amount of kinetic energy as the molecule of the gas. Now when a number of things are intimately mixed together they are thereby compelled to come to the same temperature. We identify the average energy of equipartition with the temperature, and it may be shown that in fact it is identical with the temperature measured on Kelvin's absolute scale. The average energy of an atom of a monatomic gas is $\frac{3}{2} kT$, where k is a known very small constant. Here is a link with pure thermodynamics, but it is still an incomplete one, since thermodynamics makes great play with a second quantity, entropy. For a full consideration of statistical mechanics it is, of course, indispensable to fit entropy into the scheme, but for my present purposes I can do without it.

I have enunciated the theorem in its simplest case and have oversimplified it in so doing. In the first place, I said nothing about the rotations of the molecules, which will also share in the equipartition. Thus a monatomic gas takes three shares per molecule, each of $\frac{1}{2} kT$, one for each dimension of space, whereas a diatomic takes five, since it can turn about two directions in space. More complicated molecules may have six shares, but for most of them other effects enter which I shall not discuss. Each atom of a solid usually has six units, three for the components of kinetic energy and three for potential energy. But there is a much more important modification which must be described.

The rule of equipartition implies the celebrated law of Dulong and Petit, that the specific heats of equal numbers of atoms of different substances should be the same. This law holds for most substances, but long ago certain puzzling exceptions were known; for example, the diamond has a much smaller specific heat than it should have. Moreover, the law implies that just as much energy should be taken to raise a body from 1° K. to 2° K., as it does from the freezing point 273° K. to 274° K., whereas it was found at the end of last century that at these deep temperatures the specific heats of all substances become very small—the diamond only differs from the rest in that its specific heat has started dropping earlier. This mysterious fact was later fully explained by means of the quantum theory, and arises from the rule that energy cannot be taken up by the atoms in arbitrary amounts but only in definite units. The way the process works may be described by a metaphor. Imagine that we have a large town, the health of which is cared for by a number of medical men. The rich men's doctors charge large fees and get few patients, while the poor ones get many small fees. I shall suppose that no doctor is allowed to change the scale of his fees. Then, when the town is prosperous, on the whole the doctors may all earn about the same money. This is the state of equipartition. But now suppose that the town is hit by an economic depression. Everyone suffers, the doctors included, but not equally, for no one will have the money for a large fee, and so whereas all the doctors will be poorer than before, the Harley Street doctors, who are not allowed to lower their fees, will be put right out of business. Consequently the total income of the medical profession is diminished out of proportion to that of the rest of the community.

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* From the Kelvin Lecture delivered before the Institution of Electrical Engineers on April 25.

This is a metaphorical description of what happens at deep temperatures. The matter is made a little harder to appreciate because it is not the separate atoms that constitute the units on which the energy is placed; it is combinations of them in the form of elastic waves of vibration. The shorter waves that require large doses of energy are frozen out and get none, and the only ones that get energy are the longer ones, which can accept it in small quantities. It is this effect that causes the specific heat to be much less at low temperatures.

PARAMAGNETIC REFRIGERATION

The first stages in the history of refrigeration were carried out by a variety of processes connected with the condensation of vapours. By such means all the permanent gases have been condensed, but at about 1° K. the potentialities of the method are exhausted. To go further a new method is called for, and this has been found by making use of magnetism. We must therefore briefly consider the theory of magnetism.

As is well known, materials may display any one of three different magnetic characters. The majority are diamagnetic. These are weakly repelled from a magnet, and their nature arises from an undamped eddy current induced in each atom as the field is put on and annihilated again when it is cut off. Diamagnetism is a phenomenon of each separate atom or molecule, and is independent of the temperature. Then there is ferromagnetism, the ordinary magnetism of iron and nickel. This is an enormously strong effect by comparison, and its theory is moderately well understood: it has interesting thermodynamical features, but they are mostly at high temperatures. The third effect is paramagnetism. In this the body is attracted by a magnet, as in ferromagnetism, but about a million times less, so that the weak attractive force is of about the strength of the repulsive diamagnetic force, or perhaps rather more. The enormous quantitative difference between para- and ferro-magnetism is due to a qualitative difference, for in paramagnetism it is the separate atoms that are responsible, whereas for ferromagnetism it is certain very intense interactions of the electrons in the atoms. Paramagnetic susceptibility is very much affected by temperature, and it is this that makes it of interest here.

Think of each atom as containing a little freely suspended bar magnet. These magnets possess energy and can rotate, and there are interactions between the rotations and the other heat movements of the atoms of the specimen. Therefore there is equipartition between them, and at ordinary temperatures we have to think of the little magnets mostly whirling round rather fast. On account of this whirling they point on the average equally in all directions and the specimen is unmagnetic. But now put it in a magnetic field. We are not concerned with the diamagnetic effect, though it will be present, but there is a second more important effect to consider. Each magnet will now no longer rotate uniformly, but will move like a flywheel a little out of balance. Some go fast, some can barely get over the dead centre, and some may happen to have so little energy that they oscillate instead of rotating. The outcome of this is that when an average is taken, the magnets tend to point slightly down the field, and thus the specimen acquires a slight magnetic moment, which agrees in direction with that of the field, and is usually strong enough to swamp the diamagnetic moment in the opposite direction. The paramagnetic moment, depending as it does on the energy of equipartition, will vary with temperature and is found to be inversely proportional to it, so that at low temperatures paramagnetics have greatly increased susceptibilities. If we could get down to the absolute zero, all the magnets would be at rest pointing down the field, and the specimen would be saturated, so that no increase of external field could increase its magnetization further. Effects of saturation are observed for some substances at the deepest temperatures, but I do not need to consider them here. It is sufficient to note that the magnetization in a given field will go up as the temperature goes down, since this suggests a method by which conversely we can alter the temperature.

The process was first proposed by Debye and independently by Giauque, and before explaining why it works we will see how the experiment is done. The first work was done with gadolinium sulphate for the reason that its paramagnetic behaviour is exceptionally well understood, but of late commoner substances, such as iron alum, have been more used. A specimen, usually in the form of a powder, is first cooled down with liquid helium. It is next placed in a strong magnetic field, as a consequence of which it begins to heat up again, but this heat is also absorbed by the liquid helium. The helium is next removed, so as to insulate the specimen, and then the magnetic field is cut off, and as a consequence the temperature drops immediately to a very low value. Technically the process is, of course, very difficult, but this drop in a single step to the lowest temperature is in some ways very much simpler than the elaborate sequence of pumping and repumping of vapours that has to be done in the earlier stages of the refrigeration.

We must now try to understand why the process works. As it is a magnetic process, it will depend on somehow getting energy out of the little magnets. A magnet placed in a magnetic field oscillates with a certain frequency, and if the field is weakened the frequency diminishes so that it oscillates more slowly. That is easy, but it is by no means so easy to see what happens to the *amplitude* of the oscillation as the field changes. It is easier to see this by taking the analogy of a pendulum so arranged that its frequency can be gradually altered. To do this we tie a bob *W* to a long string and make the other end fast at *A*. The string passes through a hole *B* in a light frame, and the frame can be slid up and down a groove vertically below *A*. It is thus only the part *BW* that swings. If *B* is low the pendulum is short and swings with a high frequency, but if *B* is up near *A* the swing is slow. What happens when we give the bob a measured amplitude of swing with *B* at the top and then slowly lower *B*? The reaction on the frame at *B* is half the time to the right and half to the left, but whether the bob is to the right or the left the reaction is always slightly upwards, only ceasing to be so at the instants when the bob is vertically below *A*. If then *B* is slowly lowered, it is lowered against a force, and so does work, and the bob therefore acquires energy. Conversely, if it is raised, the frame absorbs work and the bob loses energy. The solution in detail shows that at every stage the energy of the pendulum is proportional to the frequency. The result is general; when a vibrating system has its frequency of vibration raised it acquires energy from outside, when slowed down it loses energy.

Applying this to our magnets, think of one of them which is doing a small oscillation in a weak magnetic field. If the field is increased the frequency of oscillation will increase, and therefore the energy of the magnet will also increase, the work for it being done by the external field. Conversely, if we start in a strong field and slowly weaken it, the magnet's energy will decrease. Thus when our paramagnetic is put into the strong field the little magnets get more energy than is justified by equipartition and this they share out, so that the specimen heats up. This heat is absorbed by the liquid helium, and the magnets are left with the equipartition energy of the liquid helium. When the field is weakened, the magnets lose most of their energy and so will have very much less than the equipartition amount. They try to restore equipartition by borrowing energy from the other parts of the system, and so the temperature is lowered.

The process works at any temperature for a paramagnetic, but is very feeble at room temperatures. It becomes effective at deep temperatures for two reasons. First, the magnetic susceptibility becomes much bigger, so that attainable magnetic fields become much more efficient, and secondly the specific heat becomes much smaller, so that a given extraction of energy changes the temperature much more. In this way it comes about that it only takes a single stage to lower temperature from about 2° K. to about 0·003° K.

Before passing on to the properties at these new temperatures, I ought to confess that in one respect I have rather simplified the statement. An atom is not so much like a bar magnet as like an electromagnet. We may liken it to a perfectly conducting ring carrying current. As the field changes, the plane of the ring changes too, and the same things happen to the energy as I have described, but they are rather more complicated because one has to consider a motion something like that of a top, and this is more troublesome to think about than that of a pendulum. I might also add that though the way I have used of watching the energy gives one an easier insight into the process, in most cases it is quite troublesome to apply, and the orthodox thermodynamic use of entropy is far simpler.

There have been several schools of workers in this field. Giauque in America was the first to apply it, and he has made a detailed study of the properties of matter round about 0·1° K. In such work as this, mere record breaking is not the main thing, and Giauque's work has been as useful as anyone's, even though others have gone much further. De Haas of Leyden has got down to about 0·003° K., and Simon of Oxford to about the same. In addition to getting to such temperatures, we want to know what they are on the absolute scale, and this calls for more elaborate work. Anyone who has studied the thermodynamics of ordinary temperatures will remember what a troublesome business it was to fix the scale by such methods as that of the Thomson-Joule experiment. As a matter of fact, the new problem has turned out to be rather easier, because heat losses at these low temperatures can be made very small, so that the system can be approximated much more easily to the ideal thermodynamic engine of Carnot, and hence the temperature can be measured directly. Even so, it is not easy work, and the lowest temperatures attained are still rather conjectural. Pre-eminent on this side of the problem has been the work of Simon and his collaborators, who have fixed the absolute temperature scale with considerable accuracy down to 0·01° K.

The properties of matter at these temperatures are interesting. First, there is to all intents no vapour left at all; it is this that makes the heat insulation so good. Then the specific heat becomes very nearly simply that of the magnets, since the other parts have so little that they scarcely count. But there are technically much more interesting features. In my description of paramagnetism I spoke of each little magnet as simply exposed to a controllable external magnetic field, but in fact it is of course also in the field of all the other little magnets. As the temperature drops, they all begin to line up and cumulatively to exert forces on one another. Each little magnet cannot be expected to know where the force on it comes from, but will react to the total field acting on it. The result is important, and was until very recently most puzzling. The old theory of these local fields was that of Lorentz, and for long it had been accepted without question. According to this theory the susceptibility should be inversely proportional not exactly to T but to $T-\theta$, where θ is a calculable temperature which for most things should be in the region of 1° K. Below this temperature the substance ought to be capable of becoming a permanent magnet; in the old days the question had only an academic interest, but with the opening up of this new range of temperatures it was interesting to see whether it would. The experiments failed to find any permanent magnetism at the predicted temperature θ, but there is a faint and rather doubtful suggestion of it at a good deal lower temperature.

This subject is much more exciting than might appear at first sight, because a similar theory was applied for electricity as well as for magnetism, and there it led to such fantastic results that for long no one was willing to face the problem at all. Just as magnetic permeability is largely due to little magnets tending to point along the magnetic field, so the dielectric constant of a non-conductor is largely due to electric dipoles twisting round under the external electric force. In particular, the large dielectric constant of water is mostly due to the strong electric moment of the two H's that lie in directions roughly at right angles from the O. Now dielectric polarizabilities are mostly much larger than magnetic susceptibilities—something like ten thousand times as large—the consequence of which is that the critical temperature for them is very much higher. For water this temperature ought to be nearly 1000° C. This is a fantastic result, for it means that if we fill a hose with water and then bring the ends together, the water ought to become violently polarized with one end positively charged and the other negatively; it would be a strong horse-shoe magnet, only electric and not magnetic. Until about four years ago, nobody knew at all why it did not do this, and the theoretical result was so contrary to the facts that anyone who realized the difficulty was frankly terrified of the whole problem. Happily we now know that Lorentz's theory is too simple, and an explanation has been found by various workers which removes the trouble by showing that the co-operation between adjacent magnets, or dipoles, needs more thorough discussion than in Lorentz's theory. No one even now knows the full answer, but it is quite clear that there is no reason to expect the onset of permanent magnetism at the critical temperature, and it is to be conjectured that it will not come at any point above the absolute zero. Reverting to the magnetic case, this same theory applies and it removes the expected trouble, but the whole subject is not even now very clear.

If it is so comparatively easy to get down to 0·003° K., what stops us there? The answer is that for each substance there is a sort of barrier preventing further chilling. One can see that when all the magnets are pointing the same way it would not be possible to get any further chilling anyhow, but some time before this point, thermodynamics shows that there must inevitably be a large increase in the specific heat extending over a certain range of temperature. This rise of specific heat checks the temperature drop, and would make it very hard to get below it. The effect is really a convenience rather than the reverse because, once the specimen has got into the range, its temperature will stay nearly constant for some time in spite of the inevitable leakage of heat into it from the surroundings. The barrier temperature can be lowered by taking a more dilute crystal, for example by mixing the iron alum with some non-magnetic alum, but the process will break down in the same sort of way that occurs in the production of cold by vapours. The diluted crystal will have fewer little magnets available for giving up their energy, and so we should have to take a larger specimen or use a stronger magnet so as to get even the same temperature drop. To get much below 0·003° K. we should therefore have to take a great bulk of inefficient material in a strong magnetic field (and, of course, in a vacuum), and it simply cannot be done technically. The method of demagnetization by means of paramagnetism is exhausted at somewhere a little above a thousandth of a degree.

NUCLEAR REFRIGERATION

This is more or less how matters stand now, but it is not necessarily the end. Not long after the magnetic method had been shown to work, it was suggested that it would be possible to get a similar process starting at the present lowest temperature and going down again by the same sort of factor to something near a millionth of a degree. The effective system was to be the magnetism in the nucleus of the atom. A good many atoms have magnetic nuclei, and their strengths are about a thousandth of those we have been discussing, and this is exactly what is wanted. The proposal was to take a diamagnetic salt of a metal of this character and work with that. The experiment was not going to be easy, because it was necessary to cool this specimen to the thousandth of a degree *in* a magnetic field by contact with a paramagnetic which had already been cooled so far by being taken *out* of the field; for this a long heat-conducting channel would be essential, and this channel, probably of liquid helium, must itself also be lowered to the temperature.

Theory, however, suggested a curious difficulty. For the process to work, it is not sufficient merely to get the energy out of the magnets, but these magnets must also be able to borrow the energy from the rest of the system so as to restore equipartition; for if they do not, we cannot say the temperature has really been lowered. It is true that at this stage there is scarcely any energy left except in the magnets themselves, but still there is some, and unless the right proportion of this is duly borrowed to restore equipartition, we cannot say that the temperature has really been lowered—for example, we could not chill a second body by placing it in contact. Now theory shows that the rate of this borrowing will depend enormously on the temperature. At 1° it is instantaneous, at a thousandth it takes seconds or minutes, but at a millionth it may easily take a million years. The heat insulation has, so to speak, become so good that different parts of the same molecule can be at different temperatures for a million years without the heat flowing from one to the other. But the same work that revealed this difficulty showed a way out. The structure of a metal is very different from that of a salt, in that, however low the temperature, there are always electrons moving about in it at high speeds—this does not contradict equipartition, but I must take that for granted. These electrons act as middle-men and succeed in bringing about equipartition quite rapidly. So it seems likely that perhaps in a few years, by the use of a metal in which the nuclei have a magnetic moment, it may be possible to reach temperatures down to perhaps a hundred thousandth, perhaps a millionth of a degree.

What will be the properties of matter there? Frankly, I do not think it likely that they will be very sensationally different from those already found at a thousandth. There are a few things we would like to know—for example, whether other metals become super-conductors besides those already found at 1°. It would also be nice to know whether the paramagnetics become permanent magnets, though I doubt if that is feasible because of the slow rate they would have in coming to equipartition with the cold body. But Simon has suggested another more remarkable idea about such temperatures, and this is that the whole idea of temperature itself fades away.

For temperature to have a practical meaning, one must be able to take the temperature of a body with a thermometer. Now this implies that the thermometer must be smaller than the body of which it is measuring the temperature, for otherwise it will itself disturb the body's heat. But there is now so little energy in the whole body that most of the time the thermometer will have none at all, and then occasionally will have much too much. To understand why this is so I may return to my metaphor of the doctors. The town is now so poor that its total capital only amounts to a few of the cheapest doctors' fees. Most of the time no one has enough money to pay a fee, but occasionally someone scrapes enough together and consults a doctor. Obviously we shall get a very different account of the health of the community according to whether we ask the fortunate doctor who has just got a fee, or one of the other members of his profession. The indefiniteness is, however, a matter of size. If we consider the health of a much larger town, or of a whole country, we shall find that there are a good many doctors who have got fees, and by averaging over them we could get an idea of the health of the community. So if we want to speak *usefully* of temperature at these very deep temperatures we must take a large body, and the colder the temperature the larger the body must be. Actually this region of indefiniteness is even now not at all far off. The first substance to show the effect would be a diamond, and it can be shown that a grain of diamond dust which is just visible will have a quite indefinite temperature at the temperatures already reached.

We seem to be ending on an anticlimax. Each successive stage in producing cold has called for greater efforts and has on the whole produced less results. In the first stage we leave all the rich variety of physical and chemical activity of ordinary temperatures—incidentally the activity that makes life possible—for the austere region of liquid helium. Here we have lost all chemistry, and have only found as compensation the interesting phenomenon of diminished specific heats and the startling fact of superconductivity. In the second stage, of paramagnetic demagnetization, there seems even less novelty, and the chief interest is in whether things will become permanent magnets. In the third stage, of nuclear demagnetization, we can not know what will happen, for it still lies in the future, but the most likely thing is that the target we are aiming at will simply fade away into indefiniteness before us.

THE ROYAL BOTANIC GARDEN, CALCUTTA

By Dr. K. Biswas,

Superintendent of the Garden

THE Royal Botanic Garden, Calcutta, situated on the bank of the River Hoogly only a few miles from Calcutta at Sibpur, offers a remarkable parallel to the Royal Botanic Gardens, Kew, which is situated on the bank of the Thames and is only a few miles from London. Both the gardens are of high scientific interest as well as of great æsthetic beauty. Both of them serve as a source of inspiration, education and research for their many visitors. To quote Sir Arthur Hill's words: "May they find in them both spiritual rest and refreshment and also that tree whose leaves were for the healing of nations".

But the Royal Botanic Garden, Calcutta, has a somewhat different origin from the Royal Botanic Gardens, Kew, which are younger than the Calcutta Garden by about fifty years. The latter started with a little more than three hundred acres of land. At present, it occupies an area of 273 acres.

Col. Robert Kyd of the Bengal Infantry, the then superintendent of the Honourable Company's dockyard and secretary to the Military Board of Fort William, a keen horticulturist, suggested on January 1, 1786, to the Governor-General, Sir John Macpherson, then officiating as Governor-General in the absence of Warren Hastings, the formation of a botanic garden in Calcutta. Without further delay effect was given to Kyd's proposal, and with the subsequent approval of the Court of Directors in England the present site, then measuring about 310 acres, immediately below Kyd's private gardens, was acquired. Col. Kyd very appropriately was also appointed as the honorary superintendent, and the work of developing this area into a botanic garden commenced with Kyd's valuable collection of exotic plants. The Garden was henceforth the property of the East India Company but under the control of the Governor-General-in-Council. This is the reason why the garden is still known among local people as the 'Company Bagan'. When the East India Company dissolved, all the rights, duties, and privileges were assumed by the Crown, and the garden became Her Majesty's Botanic Garden. Apparently on the constitution of the Province of Bengal in 1834, the control of the Garden passed on to the local government. The epithet 'Royal' came to be applied to it after the Queen's Proclamation of 1857. Kyd continued to perform the duties as superintendent until his death in 1793.

Dr. William Roxburgh, the Company's botanist in Madras, was appointed as the first official superintendent in 1794. He was the first to draw up a catalogue of 3,500 plants then growing in the Garden. This catalogue, "Hortus Bengalensis", in two parts, was published after Roxburgh's departure from India in 1813 by his friend Carey, the celebrated missionary. Roxburgh's "Flora Indica", his "Plantae Coromandelianae" composed of three volumes, and his magnificent large portfolio of coloured illustrations numbering 2,382, embodied in thirty-five volumes prepared during his period 1794–1814 with the help of Bengali artists, forms the basis of Hooker's flora of British India and many subsequent works on Indian plants. Roxburgh's work fully entitled him to the title of 'the father of Indian botany'. The famous scientific society under the title of the "United Brotherhood" was established at this time by Roxburgh's preceptor, John Gerard Koenig, a pupil of Linnæus, who was the guiding spirit of botanical studies in India.

In 1817, N. Wallich, an able and energetic botanist, was appointed and he held office until 1846. At his time the eastern portion of the Garden, measuring forty acres, including the teak plantation, was given up by the Government to the Lord Bishop of Calcutta (Dr. Middleton) as the site for a Christian College known as the Bishop's College. This college, since 1880, has been the Bengal Engineering College, Sibpur. In 1836, about two acres of land were allotted to the Agricultural and Horticultural Society of India, which was founded in 1820 by William Carey, its first president. This area expanded to about twenty-five acres, where the Society, in co-operation with the Garden officers, conducted the greater part of its work for about forty acres until 1872, when the Society's garden was transferred to its present site in Alipur.

Dr. Nathaniel Wallich undertook an extensive survey of a large part of the Indian Empire, particularly in the little-known regions of Kumaon, Nepal, Sylhet, Tenasserim, Penang and Singapore. His enormous collections were catalogued and named in Europe by himself, with the help of other botanists. They were then distributed to all the leading botanical institutions in Europe. A more or less complete set of this valuable collection, however, is still in the Calcutta Herbarium, together with Wallich's voluminous catalogue and his correspondence during 1794–1829, which were transferred to the Calcutta Herbarium from India House, London. Through the munificence of the East India Company, Dr. Wallich published his "Plantae

Asiaticae Rariores", three superb volumes of illustrated coloured figures.

Dr. Wallich, who was not only superintendent of the East India Company's gardens but also professor of botany at the Medical College, Calcutta, and superintendent-general of the Government Teak Plantation in Bengal, retired after thirty years of service in 1846 and died in 1854. He was followed by Hugh Falconer, a palæontologist, who held office until 1855. Early in 1848, during G. McClelland's officiating period, Sir Joseph Hooker visited the garden on his famous journey to Sikkim, and again on his return to Calcutta in 1850.

Falconer was succeeded by Dr. Thomas Thomson, a traveller and a botanist of much ability. Dr. Thomson was also president of the Agri-Horticultural Society (1859–1860), the coadjutor of Sir Joseph Hooker in the collection and distribution of an extensive and well-known herbarium of East Indian plants and the joint author of the first volume of the "Flora Indica". Thomson retired in 1861 and was succeeded by Dr. Thomas Anderson, whose untimely death in 1870 was caused by a disease contracted during his effort for the introduction of quinine-yielding cinchonas into the Sikkim Himalayas. Dr. Anderson was not only superintendent of the Royal Botanic Garden, Calcutta, and professor of botany but also the first conservator of forests for Bengal and in charge of the introduction and cultivation of cinchona in India.

In 1864 occurred the great cyclone of Calcutta. It was accompanied by a storm wave from the River Hoogly which laid the greater part of the Garden under water, in some places to a depth of six or seven feet, and carried two ships into the Garden with great violence. More than a thousand trees—at least one half of the total number in the Garden—and innumerable shrubs were prostrated. The survivors were much shattered, and scarcely a vestige of leaf, flower or fruit remained. Three years later a less severe but still very destructive cyclone, in which more than 760 of the surviving trees were blown down, completed the ruin. The removal of the wreckage occupied most of Anderson's remaining time in the Garden, but before he left in 1868 he had planned and begun to give effect to the planting of the Garden on a more or less formal systematic arrangement.

In 1871 Dr. (afterwards Sir) George King took charge of the Garden, which was not in a promising state. Sir George began the remaking of the Garden. The whole extent of the grounds was raised in level, the necessary soil having been obtained where large sheets of ornamental water have since been placed. These artificial lakes have been connected with each other by underground pipes, and a steam pump (and now an electric pump) has been supplied, by which the water in the whole system can be set at a high level by means of water pumped up from the river. Numerous wide roads have been made through the Garden. Many footpaths have also been made. The bamboo and mat erections which used to do duty as conservatories have been replaced by three large structures of iron. The valuable collection of dried plants has been suitably housed in a building designed by Mr. E. J. Martin, the Government architect. The internal arrangements of this building are adapted from those of the new Herbarium building at Kew.

King made remarkable contributions to Indian botany, and initiated the publication of the *Annals of the Royal Botanic Garden, Calcutta,* in 1887; vol. 14, Part 2 appeared this year. Sir George also moved at this time for the establishment of the Botanical Survey of India, which originated in 1890; the first record of the Botanical Survey of India appeared in 1893.

Lieut.-Colonel (now Sir David) Prain, who was first appointed as curator of the Herbarium, succeeded Sir George King, who after twenty-six years of meritorious service retired in 1897 and became the director of the Royal Botanic Gardens, Kew. Before Sir David left India in 1904 he sketched out a geographical

PALMETUM OF THE ROYAL BOTANIC GARDEN, CALCUTTA.

plan of garden divisions in accordance with which future plantings were to be regulated. Sir David Prain's plan, with slight modifications, has continued to be carried on by his successors as opportunity allowed up to the present day. Sir David retired on July 30, 1906, and took over the directorship of the Royal Botanic Gardens, Kew.

Lieut.-Colonel A. T. Gage was also first appointed as curator of the Herbarium and then succeeded Sir David in 1906. A catalogue of non-herbaceous phanerogams cultivated in the Royal Botanic Garden, Calcutta, prepared during Gage's time was published with the object of facilitating the exchange with other botanical institutions of plants, seeds, or materials for systematic, anatomical, physiological or chemical investigation. Gage was also professor of botany in the Medical College, Calcutta. He retired in 1923. During his absence on leave in 1908 Mr. W. W. Smith, now Sir William Wright Smith, keeper of the Royal Botanic Gardens, Edinburgh, and professor of botany in the University, who was then the curator of the Herbarium, officiated as the superintendent. Afterwards Mr. C. C. Calder was appointed as curator of the Herbarium after Smith. Mr. Calder succeeded Gage in 1923 and retired in December last year.

In the open garden there are about 15,000 trees and shrubs. In addition to these there are several thousand herbaceous species in the palm houses, orchid-houses and ferneries. The Garden, however, is by no means so rich in species as it might be, the total number of species in the open probably not exceeding 2,500.

The scheme adopted thirty-four years ago was to treat the Garden as a map of the world on Mercator's projection representing the tropical floras. The plants of India and Burma are to occupy the central triangular area of the large western part of the Garden, this area being again subdivided in accordance with the geographical subdivisions of the Indian Empire. To the west and south-west of the large central Indian area are the divisions for north-west Asia, Europe, then America, Africa, and Madagascar, and to the east of it the divisions for north-east Asia, China, Japan, the Philippines, Thailand (Siam) and Annam, the Malaya Peninsula and Archipelago, and Australasia, the last five being separated from the large central Indian divisions by the special collections of palms, screw-pines, and bamboos. Scattered throughout the Garden are twenty-six irregular lakes, some of which are of large extent with islands. Altogether the lakes comprise about one-ninth of the total area of the Garden. Most of them were designed by King with such skilful diversity of outline and surroundings as to enhance very greatly the beauty of the garden.

The work of both the Herbarium and the Garden is dependent to a considerable extent on botanical explorations. For this reason, the Botanical Survey of India evolved from the Botanical Garden. The work of the Botanical Survey of India and of the Garden with its Herbarium are so much interdependent that since the inception of the Survey in 1890 the superintendent of the Royal Botanic Garden has been the *ex-officio* director of the Botanical Survey of India. Botanical exploration is essential for utilizing the vegetable resources of the country and maintaining the vitality of the Herbarium and the Garden. A glance at a map of India showing the explored and unexplored regions will indicate what an enormous amount of work in this direction remains to be done.

The Herbarium and the Library have been developed since the foundation of the Garden in 1786. The present damp-proof and fire-proof building, especially designed to house nearly two and a half million sheets of herbarium specimens which form the basis of all botanical and allied investigation, was erected in 1883. In this Herbarium are a very complete collection of the dried materials of plants of the whole of the Indian Empire and also fair collections of those of Asia

OREODOXA AVENUE IN FRONT OF THE RIVER GATE OF THE ROYAL BOTANIC GARDEN, CALCUTTA, BEING THE KYD MONUMENT.

outside India, of Europe and Australia. Plants of Africa and America are far less perfectly represented. The Herbarium is an essential adjunct to a botanical garden of this standard.

Introduction of quinine, rubber, ipecacuanha, various timber trees, fibre- and oil-yielding plants and other plants of great economic value is mainly due to exploration by the scientific officers of the Garden. Almost all the road-side trees and ornamental garden plants now found widely growing throughout India and Burma were first acclimatized in this Royal Botanic Garden. They were then distributed all over India and abroad. Of recent introduction is the tung oil tree, which is a source of considerable revenue in China. Experiments at this Garden indicate possibilities of cultivation of tung oil in suitable areas of Bengal in the drier lower ranges of the Himalayas at 2,000–5,000 ft. There is no reason why India should not be made self-supporting with regard to the supply of this oil, so useful for various purposes. The Garden distributes seeds to various parts of India.

The garden roads were never intended for the heavy traffic that daily passes over them. In this sense the Calcutta Gardens must be unique. In most Gardens of similar dimensions and with similar objects the visitor passes on foot ; the restrictions placed upon him read very much alike wherever one goes. Custom and long precedent have allowed greater latitude to the visitor to Sibpur. Except in some of the nursery plant houses he can wander where he likes ; he picnics anywhere and he even lights fires in approved spots when he wishes to cook his food. It is all to the benefit of the Garden, in that greater public enjoyment and therefore support is ensured, and on the whole it must be said advantage is not taken of the latitude allowed.

OBITUARIES

Mr. H. J. Carter

BY the death of Herbert James Carter on April 16, Australia has lost one who had taken a prominent part in both educational and scientific affairs. He was born at Marlborough, Wilts., on April 23, 1858, the son of James Carter, and was educated at Aldenham School and the University of Cambridge, where he was a scholar of Jesus College. He was a mathematics master at Sydney Grammar School during 1881–1901 and was principal of Ascham Girls School from then until 1914. He was president of the Linnean Society of New South Wales during 1925–26, and a member of its Council from 1920 until 1939 ; also a fellow of the Royal Entomological Society of London. For many years he was honorary entomologist to the Australian Museum. He was science editor of the "Encyclopædia of Australia" published in 1926, and author of "Gulliver in the Bush" in which he related many of his experiences in pursuit of his scientific work.

Carter's special work was with the Australian Coleoptera, especially the families Tenebrionidæ, Buprestidæ, Cistelidæ, and Dryopidæ. In addition to descriptions of large numbers of new species, he paid particular attention to matters of synonymy, and published a number of check-lists of the families, and revisions of the Australian species of various genera. He did not shirk the drudgery of the work on synonymy, but often deplored the practice of some European colleagues who, on what he considered inadequate evidence, described large numbers of Australian species as new, and so added to the difficulties of Australian coleopterists.

His papers appear in a number of scientific journals from 1905 onwards, chiefly those of the Linnean Society of New South Wales, the Royal Zoological Society of New South Wales, and the Royal Society of South Australia. His last completed work was a short note on Dryopidæ, handed to the Linnean Society of New South Wales only a few days before his death, with the comment that he found such small objects trying to his sight and that this would probably be his last contribution on the family. His fine collection of Australian Coleoptera, including many types, will go to the Division of Economic Entomology of the Council for Scientific and Industrial Research at Canberra. A charming personality, he left a host of friends in his scientific colleagues and in his former pupils now scattered throughout Australia.

Prof. C. L. Boulenger

PROF. CHARLES L. BOULENGER, who died on May 21, aged fifty-five, will be remembered as a successful professor, an authority on freshwater medusæ and the trainer in helminthology of a large band of biologists who were scattered through the East for disease diagnosis in the War of 1914–18.

His father was G. A. Boulenger, F.R.S., a Belgian who became a great authority on reptiles and fish at the British Museum (Natural History). The son was a scholar of St. Paul's School and entered King's College, Cambridge, in 1903 as Lawrence Saunders scholar. He obtained first classes in the Natural Sciences Tripos and in 1906–7 occupied his University's table at the Stazione Zoologica, Naples, for the study of medusæ. He then visited Birket el Qurun (the remains of Lake Moeris) to investigate its medusa, discovering that its stinging cells are formed in the endoderm of the manubrium and in the ectoderm of the swellings at the bases of the tentacles before migrating to accumulate in surface batteries in the manubrium and tentacles respectively. This work was followed up by nine reports on medusæ from Tanganyika, Rhodesia, the Limpopo and the Caspian, chiefly concerned with their development and meristic and genetical variation.

After a year's demonstrating at Oxford, Boulenger returned to Cambridge in connexion with the museum, also demonstrating, particularly taking charge of Sir Arthur Shipley's advanced classes on the flatworms, nematodes and other parasites. In 1910 he went to Birmingham as lecturer and three years later was appointed reader in agricultural zoology. This was preceded by important work on the Myzostomida, external parasites of starfish, of which he received 170 specimens collected by Crossland from the Red Sea, this collection about doubling the known specimens. They were referred to six species with a full account of their anatomy. A report on a sheep's nematode (Nematodirus) followed, important for the development of cultural methods that enabled him to present its full life-history.

In 1915–16, Boulenger, under the Royal Society's scheme, lectured and demonstrated at Cambridge on the higher parasites of man. He then proceeded to Basra (Captain R.A.M.C.), where he acted as referee for worm parasites while making routine examinations for amœbic dysentery. He tabulated the stools of 1,180 patients, finding the British (about a third) quite free, while of the whole number 18·5 per cent had hookworm, 5·2 per cent Ascaris and 5 per cent Trichiurus, not large numbers, since Turkish prisoners proved to have four times these infestations. Unfortunately, he contracted amœbic dysentery, but in 1920 returned to India as professor at Lahore, working in the Punjab Veterinary Laboratory and specializing in the strongylid parasites of camels and horses. In 1921 he was appointed professor at the Bedford College for Women. To this he gave all his powers, fighting ill-health, for he never recovered from his Mesopotamian breakdown. He never married.

As a student Boulenger was very competent, but shyness caused him to be a solitary person and to build up a life within himself, ceramics and mezzotints then attracting him. This character he never lost, and perhaps it is the key to his life, if coupled with a strict obedience to duty. His lectures were models of clarity and balance, relieved by a marked touch of humour. He kept a high standard before his students, but was singularly understanding of their difficulties and always helpful; as an examiner he was remarkable for his judgment and appreciation of originality. With Prof. D. Mackinnon he effectively collaborated in providing a course in parasitology for the University of London. Every year he sent one of his students to Plymouth, providing anonymously the necessary funds by means of a prize. He was an admirable colleague, his views on college policy sound and strongly held. As he grew older his health became worse and he only found relief in the 'long' vacations at Algeria and Tangiers where he almost lived in the sea. In the winters he had his ticket for Covent Garden and gave play to his collector's instincts, especially in philately and oriental jewellery. J. S. G.

Prof. Michael Siedlecki

PROF. MICHAEL SIEDLECKI, who, during the occupation of Cracow by the Germans in November 1939 was imprisoned with the majority of the professors of the Jagellonian University, and transferred to the concentration camp in Oranienburg near Berlin, died there in January 1940.

Prof. Siedlecki was professor of zoology and director of the Zoological Laboratory and Museum of the Jagellonian University of Cracow, member of the Polish Academy of Sciences, honorary doctor of the University of Strasbourg, and member of many Polish and foreign scientific societies, including the Zoological Society of London. He was born in Cracow in 1873, and having taken the Ph.D. of the University of Cracow in 1895, he spent some years abroad completing his studies in zoology in the Universities of Berlin and Paris and at the Zoological Station in Naples. After his return to Cracow he continued zoological research in the University, first as an assistant, then as a lecturer in 1900, and finally as a professor without a chair. During 1908–9 he made a scientific expedition to Java and in 1912 succeeded Prof. Antoni Wierzejski in the chair of general and systematic zoology at the Jagellonian University.

In 1919, Siedlecki went to Vilna, to organize the new Polish university there, and remained until 1921, as the first rector of the University. He then returned to Cracow, to his former post as professor of zoology. Since 1923, Prof. Siedlecki represented the Polish Government on the Conseil Pérmanent International pour l'Exploration de la Mer in Copenhagen. He devoted much time to the organization of the Polish fisheries in the Baltic, and in the North Sea. He also organized the scientific investigation of the Baltic adjacent to the Polish sea-coast. Thanks to his efforts the marine stations at Hel and Gdynia were formed as the centre of scientific research of marine biology in Poland.

Most of Prof. Siedlecki's scientific researches concerned protozoology, especially the parasitic protozoans of the groups Sporozoa and Flagellata. He discovered and described a number of new and very important facts concerning the structure and development and reproduction in these groups, which are frequently cited in treatises and text-books on zoology. He was also interested in many other problems of animal biology, as is evidenced by his studies on tropical insects and amphibians. In the last years of his life his research was devoted almost entirely to marine biology, particularly to the biology of fishes inhabiting the North and Baltic Seas.

Prof. Siedlecki also took a great and active interest in the preservation of wild life. He organized the Polish Section of the International Committee for Bird Preservation, and was its chairman until 1937.

when, though still taking a prominent part in the work, he relinquished his position to Prof. Count Kasimerz Wodzicki. He was a member of the subcommittee appointed by the International Committee for Bird Preservation to examine and coordinate the proposals put forward by the National Sections of Europe for the Revision of the International Convention for the Protection of Birds (Paris 1902), and presided over many of its deliberations. He represented the Polish Government at the International Ornithological Congresses in Amsterdam in 1930 and in Oxford in 1934. Prof. Siedlecki's knowledge of international affairs, his diplomacy and his personal charm were of inestimable value at the many international meetings he attended; he was deeply respected by everyone with whom he came in contact, of whatever nationality, and those who had the privilege of working with him will always remember him with a lasting affection. Prof. Siedlecki was a man to whom the word 'cultured' could be applied to its utmost meaning, from his great knowledge of art, literature, architecture and history to his gentleness and courtly manner. But above all Siedlecki was a patriot, and his burning love for his country was an inspiration.

We regret to announce the following deaths:

Prof. L. S. Bagster, professor of chemistry in the University of Queensland, Brisbane, aged fifty-three.

Sir Arthur Harden, F.R.S., emeritus professor of biochemistry in the University of London, formerly head of the Department of Biochemistry in the Lister Institute, on June 17, aged seventy-five.

Prof. Samuel Klein, professor of the historical geography of Palestine in the Hebrew University, Jerusalem.

Dr. G. A. Loveland, formerly chief meteorologist of the Boston Weather Bureau, on March 30, aged seventy-six.

Dr. E. F. Northrup, vice-president and technical adviser of the Ajax Electrothermic Corporation, formerly assistant professor of physics in Princeton University, on April 29, aged seventy-four.

Prof. F. H. Probert, dean of the College of Mines, University of California, on May 9, aged sixty-four.

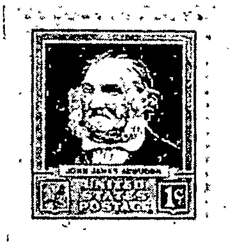
Prof. R. H. True, emeritus professor of botany in the University of Pennsylvania and director of the Morris Arboretum, who was known for his work in plant physiology, on April 8, aged seventy-three.

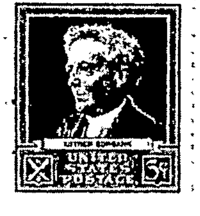
NEWS AND VIEWS

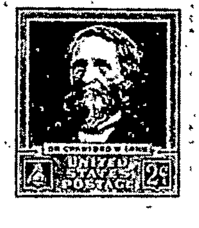
Commemorative Stamps to American Science

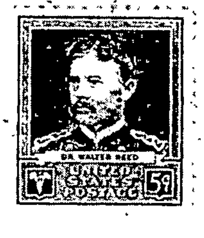
A new one-cent stamp in honour of Audubon was issued in St. Framisville, Louisiana, on April 8. J. J. Audubon (1785–1851), the well-known naturalist son of a Frenchman, worked almost solely on American animals, his greatest work being "Birds of America". This work contained 435 hand-coloured plates with 1,065 life-sized figures of 489 distinct species of birds. Audubon was the pioneer in the portrayal of birds in their natural positions and environment. The three-cent stamp in honour of Burbank was issued in Santa Rosa, California, on April 17. Luther Burbank (1849–1926) was the famous American plant breeder. Most of his work was carried out at Santa Rosa, which he described as "the chosen spot of all this earth as far as Nature is concerned". His most important early work, in 1872, was that of the development of the Burbank potato. Later, he worked successfully on the plant genera Rubus and Prunus.

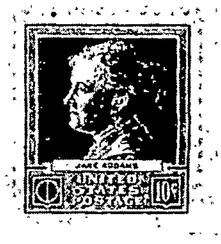
Dr. Crawford Long (1815–1878), in whose memory a two-cent stamp was issued in Jefferson, Georgia, on April 8, was a pioneer in the use of ether as an anæsthetic. He administered ether for the first time in surgical history on March 30, 1842, in an operation for the removal of a tumour from the neck. The first account of his discovery was published in 1849. Dr. Walter Reed (1851–1902), the American bacteriologist attached to the army, disproved the then prevalent theories of the transmission of yellow fever and finally succeeded in showing that the parasite was transmitted by the mosquito *Stegomyia fasciata*. He also showed that the bite was effective only under certain conditions. A commemorative stamp to the value of five cents was released in Washington on April 17. A ten-cent stamp in honour of Jane Addams, the American sociologist, has also been released. Her greatest achievement was the establishment of the well-known social settlement, Hull House, in Chicago.











The *Bulletin Analytique*

THE *Bulletin Analytique* is a journal of abstracts, issued by the French Government's new Service de Documentation (see p. 947). The director of the Service is Prof. P. Auger, and the chief editor of the *Bulletin* is Dr. N. Thon. The Bulletin was to have been issued in fortnightly parts. The first six parts, for January–March of this year, have been published in one fascicule. Nos. 7–8 appeared in April and No. 9 is dated May. The size of the page is about 6¼ in. × 9½ in. It is hoped that a complete annual volume will contain about one thousand pages. The abstracts are classified under eighteen subjects, which are : mathematical physics ; corpuscular physics ; structure of solids and liquids ; mechanics and heat ; radiation and optics ; electricity and magnetism ; astrophysics and geophysics ; thermodynamics and chemical statics and dynamics ; electrochemistry, photochemistry, radio chemistry, and photography ; colloids and adsorption ; chemistry of minerals, mineralogical chemistry and geochemistry ; organic chemistry ; metallurgy ; industrial chemistry and materials ; agricultural chemistry ; biological chemistry ; agriculture ; physiology. The titles of all papers and all abstracts are given in French, with the name of the author, the place where the research has been done, the journal in which it has appeared and the language of the original. Abstracts of unpublished papers in the Service's archives are given a special mark.

Emile Duclaux

PROF. PIERRE EMILE DUCLAUX, the well-known chemist and bacteriologist, was born at Aurillac, capital of the Cantal Departement of France, on June 24, 1840. In 1857 he went to Paris, where he was educated at the Lycée Saint Louis. Two years later he passed the entrance examination not only at the Ecole Polytechnique but also at the Ecole Normale Supérieure, where Pasteur, with whom he became closely associated, was sub-director of scientific studies. In 1862 he became an *agrégé* and assisted Pasteur in his investigation of the disease of silkworms which was then prevalent in several departments of France. In 1865 he was appointed professor of chemistry at Tours, from which he was transferred in a similar capacity to Clermont-Ferrand, where he had about a hundred pupils, most of whom were medical students, including Emile Roux, his successor at the Pasteur Institute. From Clermont-Ferrand he went to Lyons, where he remained five years as professor of physics. Finally he settled in Paris in 1878 as professor of physics and meteorology in the Agronomic Institute.

In 1886, Duclaux was appointed professor of biological chemistry at the Sorbonne and held this position until his death. In 1888 he was elected a member of the Academy of Sciences in the section of rural economy, and in 1894 he became a member of the Academy of Medicine. In 1895 he was appointed Pasteur's successor in the Institute in the Rue Dutot. In the words of Prof. H. Roger, "Duclaux possessed all the essential qualities of a professor—erudition, critical sense, a lucid style and a taste for polemics". He was a remarkably prolific writer. In addition to more than eighty articles dealing with molecular physics, chemistry, meteorology, enzymes, physiology of digestion, vegetable physiology, bacteriology, etc., he was the author of a number of books, including "Ferments et maladies" (1882), "Le Microbe et la maladie" (1885), "Pasteur, Histoire d'un esprit" (1896), which was translated into English in 1920, "Traité de Microbiologie" (1898–1901) and "L'hygiène sociale" (1902). He was also founder in 1887 of *Annales de l'Institut Pasteur*. He died on May 3, 1904.

Huxley's Teaching at Edinburgh

DURING the four years when the *Challenger* was sailing the oceans of the world, Sir Wyville Thomson left his natural history class-room in the University of Edinburgh to lead the expedition. The vacancy was filled temporarily by two naturalists of European fame—Julius Victor Carus, of Leipzig, who conducted the zoology courses in the summer sessions of 1873 and 1874, and Thomas Henry Huxley in 1875 and 1876. An account of their tenure of the natural history chair, by Prof. James Ritchie, appears in the summer number of the *University of Edinburgh Journal* (pp. 206–212), the information about Huxley being gathered mainly from the class roll-books, and from a small notebook of Huxley's dealing with "Lectures, Edinboro", in the Huxley Library of the Imperial College of Science and Technology. Huxley drew a crowded audience for his introductory lecture on "The Crocodile"—it was a free lecture—and he laments that many parsons were present who "came to curse and didn't remain to pay". His course proper, covering twelve weeks, traversed the whole animal kingdom from Protozoa to Mammalia, and was predominantly morphological and classificatory, although generally some reference was made to development and to the fossil record of a group.

It was a heavy programme, and Huxley as well as the students felt the rush and strain. Joseph Thomson, student in 1876, who became one of the greatest of the geographical pioneers in Africa, wrote, "Huxley's usual lectures are something awful to listen to . . . to master his language is something dreadful", and yet "I would not miss them . . . they are something glorious, sublime". Huxley's own impression of the course was equally definite. "I . . . positively polished off the Animal Kingdom in fifty-four lectures. French without a master in twelve lessons is nothing to this feat." The class roll-books show that a practical class in zoology was first held in 1872 under Wyville Thomson, but except for a short record in the University Calendar there is no record of the scope of the work of the earliest practical classes. Huxley's notebook indicates that the class, conducted by the assistant under the professor's supervision, examined fourteen different types, and Prof. Ritchie points out the curious fact that the practical class appears to have traversed the animal kingdom from Vertebrates to Infusoria almost in the reverse order from that adopted in the lectures.

The Religion of the Future

IN an article "Brave New World Planning" in the *Quarterly Review* of April, W. J. Blyton stresses the importance of such values as freedom with discipline, personal character, room for spontaneity and the spiritual as a basis for a new world order. Character and not mechanisms must come first, and only a better and stronger religion will overthrow the passionate and evil religions which at present menace the world. Without that, democracy will not be enough, and Mr. Blyton argues that the League of Nations failed because its foundations were legalist, secular and without spiritual appeal, moral authority, or imaginative hold on the stormy wills of men. No future order, he urges, will last unless it is viewed as sacred by a vast majority who have to live under it. It must be loved and valued as England (or other *patria*) now is ; as one's religion is ; or one's family, personality and liberty. A wave of moral conviction and spiritual vision must pass over many nations, and the comprehensive order will grow out of close, friendly but not firmly defined relations. The entire mundane political business hinges on virtue, which can be analysed into conscientiousness, sympathy, self-discipline and moral insight, and great and good achievements are not officially inspired by law, resolution, or orders. Education in the limited materialist, utilitarian sense of the word is nought. To roll back the tide of Belial and Moloch we must oppose a true religion, instinct with love, works of mercy, the new life, the inescapable mysteries of life and death.

Culture, Diet and Teeth

WHILE the excellence of the teeth of primitive peoples, in the sense of an absence of caries, even though the teeth may be much worn by rough or coarse food, has been a subject of frequent reference by travellers and anthropologists, it is infrequent that direct evidence is available of the relation of diet and state of the teeth to which this character in the people is referred, usually in quite general terms. Yet obviously the question is one of considerable importance in evaluating the sum total of the effects of changes in culture which have recently taken place and are continuing among peoples of backward civilization in their contacts with Europeans.

A valuable observation of the mechanism of dental deterioration through cultural change is afforded by the field observations of Dr. Helen Mellanby of the University Field Laboratories, Sheffield, on the teeth of a number of Finnish Lapp children, reference to which is made on p. 978. Among these children a remarkable degree of dental hypoplasia appears and, as was to be anticipated, this was accompanied by an equally high percentage of carious affection. The interest and significance of the observations, however, was enhanced by a fortunate opportunity for comparing a part of this material with teeth from skulls from the same group of Lapps, dating back from fifty to two hundred years, in the Helsinki Museum. As compared with the teeth from this source, the teeth of the modern children showed a marked deterioration in structure, and a similar impression was conveyed by the teeth of the adult skulls, as compared with the teeth of the modern adult population, though no exact observations were made.

It has been shown that the structure of the teeth is dependent to a large extent on diet, and in attempting to account for this very evident deterioration in the structure of the teeth of modern Inari Lapp children, Dr. Mellanby puts forward the suggestion that while Inari Lapp culture has suffered less change than that among any other body of Lapps, their diet, which formerly was based upon a reindeer cultural economy and was almost entirely carnivorous without bread, has now become one based on mixed farming with reindeer keeping, in which the diet depends upon 'civilized' substitutes with large quantities of cereals. Comparative figures from Greenland quoted by Dr. Mellanby may be interpreted in like manner as emphasizing the effect of cultural change in an alteration of diet as affecting the character and health of the teeth. While the teeth of the children of the remote parts of East Greenland are probably the least carious of any (excluding the tropics), those of West Greenlanders, who are 'civilized', are slightly worse than those of children of the Danish elementary schools, among whom defects of 31 per cent for deciduous and 34 per cent for permanent teeth have been recorded.

Plant Foods of Australian Aborigines

IN a reference to a publication made some time ago by Mrs. I. W. Dadswell (*Austral. J. Exp. Biol. and Med. Sci.*, 12, 13 (1934), Sir James Barrett points out that all the useful plants and animals now established in Australia were imported. The criticism that the aborigines never cultivated a plant nor domesticated an animal as a source of food is equally applicable to Europeans, in so far as the indigenous flora and fauna are concerned. Yet the aborigines, whom we are accustomed to regard as an uncivilized vestige of the Stone Age, have adapted themselves to their environment so as to be able to live and thrive where Europeans would starve. Thus, Governor Phillip had to ration the first settlement at Sydney Cove in 1788 ; and white men lost in the bush have usually perished unless helped by aborigines.

Mrs. Dadswell, working in the Department of Biochemistry of the University of Melbourne, found that certain vegetable foods eaten by the natives of Central Australia, and collected near Mt. Liebig in the Alice Springs region, do not differ greatly from corresponding cultivated foods in their organic composition, and that the necessary inorganic constituents, with the exception of phosphorus, are plentifully supplied in these foods. Thus, the fruit of *Solanum ellipticum* is bracketed with the tomato, the root of *Portulaca oleracea* with the carrot, parsnip and turnip, the tuber of *Ipomœa* sp. with the sweet potato, and the leaves of *Celendrinia balonnensis* with cabbage, lettuce and spinach. The moisture content of the fresh native foods was lower than that of similar cultivated foods ; the total ash was higher ; calcium, magnesium and iron were abundant. In further investigations of the kind, which are contemplated, it would be of interest to include a reference to the vitamins of these native foods, and also to record any occurrence of sugars. According to the late Mr. H. G. Smith, of the Sydney Technological Museum, sugar in any form was a great attraction to the aborigines, who prized highly such sweet rarities as "Eucalyptus manna" (raffinose from certain punctured eucalypts) and "lerp" (a protective secretion of Psyllideæ).

Conservation in Canada

WRITING in the second issue of *Canadian Nature* (Whittemore Publishing Co., Toronto), Mr. Alan F. Coventry deals at length with an interesting experiment in conservation made on 88,000 acres at King Township, near Toronto. A survey of natural resources found the human population to be 4,600, and since 1840 the wild-life has decreased through human interference. The only large mammals left are deer on Holland Marsh; the imported European hare is one of the most abundant, first appearing in 1925, and the area seems to be the northern limit for winter survival of the imported ring-necked pheasant. Depletion of natural water supplies and need for reafforestation are also noted. It is pointed out that the findings of the survey are applicable to a large part of southern Ontario, and similar surveys to the King Township investigation are recommended for other regions, so that the information gained can be used for conservation and for remedies to overcome increasing tendency towards flood and drought dangers. In no more than a century, about 2,500 acres have been abandoned as no longer fit for cultivation.

Conservation apparently plays a large part in the purpose of *Canadian Nature*, but there is no superabundance of sentimentality which deters the scientific naturalist from so many publications related to wildlife. An account is given of the Federation of Ontario Naturalists' Summer School at Camp Franklin, Parry Sound, and Prof. J. R. Dymond, of Ontario Museum, writes the "guest editorial", which is apparently to be a feature by notable authorities.

Primitive Insects of South Australia

UNDER this title Mr. H. Womersley, entomologist at the South Australian Museum, in Adelaide, contributes a useful handbook (dated 1939) on the lower insects, or Apterygota, of the country named. Recognizing the need for a wider diffusion of accurate knowledge of the fauna and flora of this region, a committee, under the South Australian Branch of the British Science Guild, has undertaken the issuing of a series of handbooks. The absence of suitable reference manuals has been a real handicap to the progress of Australian biology, and those which have already been planned, or issued, are prepared gratuitously by South Australian biologists and geologists: they are printed and published by the State Government and are available for sale at low prices. Some fifteen of these handbooks have now been issued and others are in course of preparation. Mr. Womersley's work is the first of the series to deal with the Insecta and comprises accounts of the orders Thysanura, Collembola and Protura. Well printed and arranged, its numerous clear and mostly original illustrations form a special feature that greatly enhances the value of this handbook. Increase in knowledge of these primitive insects has been rapid: thus in 1932 no Protura had been recorded from Australia, whereas eight species are now known. In 1926 only about forty species of Collembola were recorded from Australia, but now Mr. Womersley accounts for more than two hundred species. The handbook is set up by the Government Printer, Adelaide, and is good value for its price, 7*s*. 6*d*.

The National Physical Laboratory

THE report for 1939 of the National Physical Laboratory covers 100 pages (London: H.M. Stationery Office. 2*s*. 6*d*. net). During the year there has been no great falling off in the experimental work done for, and the advice given to, industry both for immediate purposes and for long-range projects for opening up new possibilities, or in the testing of instruments or the maintenance of exact standards of measurement. But the War has raised new problems for solution which have come from the Services and the civil defence departments. Changes of staff to and from industry, to the Admiralty, the Air Ministry and the Forces have been more numerous than usual. Among the investigations of the year may be mentioned those on the physical properties of carbon steels, light aluminium and magnesium alloys, ship propellers, new aircraft, the reduction of sound transmission in buildings, electrical insulating materials and the propagation of ultra-short radio waves. Members of the staff have continued to give lectures on the work of the Laboratory at provincial centres, to serve on technical committees at home, and to attend international conferences on scientific and technical questions abroad.

Life Expectancy in the Philippines

IN a recent communication (*Acta med. Philippina*, 1, 217; 1940) emanating from the Institute of Hygiene of the University of the Philippines, A. G. Sison, H. Lara, M. M. Herbosa and A. A. Lozano have compiled an instructive paper illustrated by 25 tables and 12 graphs of the life expectancy in the Philippines in 1902 and 1918. Their conclusions are as follows. The average expectation of life for both sexes in 1918 was 26·5 years, as compared with 17·91 years in 1902, which meant an improvement of approximately 9 years. For males the average expectation of life was 17·56 years in 1902 and 27·15 years in 1918, the corresponding increase being approximately 10 years. In 1902 the average expectation of life for females was 18·67 years and in 1918 26·38 years, an improvement of approximately 8 years. The complete expectation of life in the Philippines at birth for males was 11·54 years in 1902 and 25·17 years in 1918, an approximate increase of 14 years. For females the complete expectation of life at birth was 13·92 years in 1902 and 26·07 years in 1918, the increase being 12·15 years. The complete expectation of life at birth for both sexes was 12·24 years in 1902 and 25·64 years in 1918, in other words, the average length of life remaining to each child born alive in 1918 was more than double that of 1902.

Raymond Sabouraud

THE specialist research worker in a limited field is not usually accorded a large share of public fame, even though his contributions be enlightened and fundamental. Raymond Sabouraud performed a surprising amount of original investigation, at the Pasteur Institute, Paris, into the fungi which cause skin diseases of animals. A paper by Dr. L. Grigoraki (*Mycopathologia*, **2**, Fasc. 3, 171–200; March 1940) indicates the historical setting of Sabouraud's activities, and shows how greatly the science of dermatology is indebted to him. Many of the skin diseases are caused by species of fungi belonging to the genus Trichophyton. No fewer than twenty-five species of this genus are from Sabouraud's original description, and his studies embraced the disease and its prevention, in addition to the causal parasite; X-ray therapy developed into a cure at his hands, with the help of his associates. Most eloquent of all, however, is the citation of Sabouraud's published works, which occupy twenty-four pages in the paper under review, and provide the only monument which their author appeared to desire.

Pest Infestation of Produce

THE Secretary of the Department of Scientific and Industrial Research announces that H.M. Government has gratefully accepted the offer of the Governing Body of the Imperial College of Science and Technology to place at the Department's disposal for the period of the War all the accommodation of the Biological Field Station at Slough that is required for the purposes of the Department's work on the infestation of produce by insects. The Department has now taken into its own employment the staff of the Imperial College hitherto engaged on the Department's work in this field, and with the consent of the Governing Body of the College has secured the services of Prof. J. W. Munro as consultant. All correspondence intended for the Department on the infestation of produce by insects should be addressed to the Officer-in-Charge, Pest Infestation Laboratory, Biological Field Station, Slough, Bucks.

Announcements

PROF. W. L. BRAGG will deliver the Norman Lockyer Lecture of the British Association at Hull on June 24.

PROF. S. S. BHATNAGAR, professor of chemistry at the University of Lahore, has been lent for two years to the Government of India as director of scientific and industrial research. Prof. Bhatnagar carried out research work at University College, London, under Prof. F. G. Donnan during the years 1919–21, and obtained the D.Sc. degree of the University of London. Since then he has built up a most successful school of research at the University of Lahore, and has himself made contributions to magneto-chemistry and other branches of modern physical chemistry, besides doing a great deal of important technical work.

ROBERT D. POTTER, news editor and staff writer in physics and chemistry for Science Service since 1934, has been appointed science editor of the *American Weekly*, a large magazine supplement distributed by many American newspapers in their Sunday editions. Mr. Potter received his B.S. degree from the University of Buffalo in physics in 1927. During 1928–32, he was a graduate assistant in the department of physics at the Washington Square College, New York University, and later became the science editor of the *New York Herald Tribune*.

THE Trustees of the Lady Tata Memorial Fund announce that, on the recommendation of the Scientific Advisory Committee, they have agreed, if circumstances permit, to make the following awards for research in blood diseases, with special reference to leukæmia, in the academic year beginning on October 1, 1940: grants for research expenses to Dr. M. P. J. Guérin (Paris), Prof. K. Jármai (Budapest), Prof. E. L. Opie and Dr. J. Furth (New York), and Dr. A. H. T. Robb-Smith (Oxford); part-time personal grant and grant for research expenses to Dr. Werner Jacobson (Cambridge).

THE Franqui Prize of half a million francs has recently been awarded by the Franqui Foundation Committee to Dr. Pierre Nolf, professor of pathology and therapeutics at Liège and member of the Belgian Royal Academy of Medicine, for his contributions to science. The former Franqui prizemen are Prof. Henri Pirenne, professor at Louvain, Franz Cumont, member of the Royal Academy of Science, and Jacques Errera, professor in the University of Brussels.

DURING 1939, 91 miners were certified to have died of silicosis and 355 certified to have been disabled by the disease in the South Wales coalfield.

A NEW institute for experimental hygiene has recently been founded at Montevideo, and will probably be connected with the Clinic for Infectious Diseases.

ACCORDING to Sir William MacArthur, Director-General of Army Medical Services, in spite of the severe winter there have been relatively few cases of serious illness among the troops and a very light incidence of acute infectious diseases.

THE number of road accidents in the Union of South Africa in 1939 was lower than for 1938 and 1937 despite the increased number of vehicles. The number of people killed was less than in any year since 1935, and in 18 chief towns it was the lowest for five years. The number of accidents was 43,205 in 1939 compared with 43,868 in 1938 and 45,947 in 1937.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 977.

Optical Sensitizing of Silver Halides by Dyes

IN a recent communication[1] we indicated the importance of planarity of dye molecules for the absorption of light and for photographic sensitizing. A further survey of cyanine dyes has shown this to be general; moreover, we find that dyes capable of planar form, but having strain on bond angles, show a *negative* temperature coefficient of absorption in solution. Increase of rotational-vibrational energy in the molecule overcomes the strain and relaxes the structure to a non-planar form. The activation heat can be equated to the potential energy of strain which is removed.

Using the same isomeric cyanine dyes previously described[1] we now have found that the planar isomers adsorbed to pure silver bromide (no gelatin) produce a normal photolysis (photo-chemical production of silver) on illumination in their absorption bands. But no photolysis was effected by the non-planar isomers, although they were equivalently adsorbed, that is, to an adsorption density corresponding to the area occupied per molecule—or molecular ion—in edge-on orthogonal orientation[2].

It appears that there is something fundamental and essential for optical sensitizing in this edge-on adsorption of *planar* dye molecules. In such molecules, the resonance and the electronic transition occurring on absorption of a light quantum are polarized in the plane of the molecule. In fact, in a great number of cases, the molecule may be regarded as a linear oscillator, so that, in consequence of the orthogonal orientation of the planar molecule to an octahedral (110) plane of the crystal, the electronic transit is polarized parallel to such a plane and in an azimuth normal thereto.

Optical sensitizing of silver halide can be shown now to exhibit some interesting analogies—perhaps close affinities—with the well-known 'selective' (external) photo-electric effect. This is an *external* effect, the electrons measured being those that pass the surface potential barrier, whereas the dye sensitizes an *inner* photo-electric process, namely, elevation of electrons from filled zones to conducting zones in the crystal. These internally liberated electrons may: (1) consummate photolysis by uniting with silver ions[2]; (2) spill over into contiguous silver metal-producing photo-voltaic effects[3]; (3) give actual photo-conductance[4] . . . in all cases for light absorbed by the adsorbed dye.

The similarities and differences between optical sensitizing and the selective photo-electric effect will be discussed in the fuller publication. The essential fact which we have brought out is that optical sensitizing not only involves a selective band (electronic transition) absorption of light, but also therewith selective polarization of the absorbed photon. The necessary and sufficient conditions for a dye to act as an optical sensitizer of silver halide appear to be:

(1) Oriented edge-on adsorption, orthogonal to a (110) plane of crystal;

(2) Planar configuration of dye molecule, respectively, of adsorbed dye ion;

(3) Electronic transition in dye ion on absorption of photon, polarized in an azimuth defined by (1) and (2).

We may suppose that the electrons of the filled (strongly shielded) zone (atomistically the Br^- ions of a 110 plane) have a vector, E_a in the 110 plane. This component may undergo partial coupling with a parallel component of the resonance energy of the adsorbed dye molecule polarized in the same azimuth. This corresponds to the displacement of the light absorption of the adsorbed dye molecule to lower frequencies than in the free, gaseous state. There is a corresponding enhancement of this component for an electron of the filled level, which becomes $E_a - h\Delta\nu$. On absorption of a quantum, $h\nu$, of light by the adsorbed dye, the coupling advances to the taking over of this whole increment of electronic oscillation, polarized in the same azimuth, by a partially coupled electron of the filled zone; the total kinetic energy of this electron in the given plane becomes $E_a + h\Delta\nu + h\nu \cong h\nu_0$, where $h\nu_0$ is the energy necessary to raise an electron to the conductance zone of the crystal. The condition becomes equivalent to that deduced by A. von Hippel[5] for dielectric breakdown in alkali halide lattices, in which it was shown that in these (cubic) crystals the electrons prefer to move through the lattice in the 110 plane.

Essentially, what is postulated is a sufficiently large coplanar component of the otherwise strongly shielded electronic energy of the filled zone to make up the energy necessary to free the electron on coupling with a photon absorbed by the dye molecule. We have shown that optical sensitizing is limited to precisely the most favourable conditions for this. The relation of the suggested mechanism to so-called metastable levels and disturbed lattice points will be discussed in the fuller publication, as also the interesting suggestion of J. Eggert[6] that in ordinary latent formation by ultra- and blue-violet light the more perfect lattice regions are acting as 'optical sensitizers' for perturbed or imperfect regions. The foregoing conclusions, derived for planar cyanine dye molecules, and 'molecular' sensitizing, are equally consistent with 'aggregate' sensitizing[2]. It has been shown that the adsorbed molecular aggregates are parallel-piled edgewise adsorbed ensembles of planar dye ions[2]. Also, it has been shown by E. E. Jelley[7] and by G. Scheibe[8] that filaments or packets of these parallel piled ions constitute a mesomorphic (initially nematic) phase of ionic miscelles. The new—and strongly shielded—electronic transition (shown in absorption, in fluorescence, and in optical sensitizing) proper to these ensembles is polarized in a direction perpendicular to the plane of the component molecular ions, that is, parallel to the axis of the packet or micelle—and, therefore, to a 110 plane of the crystal. The coupling of this with the azimuthal component of the electronic energy of a filled zone could proceed, therefore, as for an adsorbed molecule. In this connexion, it is significant that we find that non-planar cyanine dyes do not aggregate in the nematic state, while their planar isomers do so.

The considerations advanced are equally applicable to acid sensitizing dyes, for example, erythrosin, etc., of the xanthene type. These also are adsorbed edgewise and orthogonally to an octahedral surface, though of silver ions[2]. The molecules of these dyes are also planar, and *a fortiori*, because having a fused polycyclic skeleton.

S. E. SHEPPARD.
R. H. LAMBERT.
R. D. WALKER.

Research Laboratories,
Eastman Kodak Company,
Rochester, New York.
April 25.

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[1] NATURE, **145**, 386 (1940).

[2] Sheppard, S. E., Lambert, R. H., and Walker, R. D., *J. Chem. Phys.*, **7**, 265, 426 (1939).

[3] Sheppard, S. E., Vanselow, W., and Happ, G. P., *J. Phys. Chem.*, **44**, 411 (1940).

[4] Kameyama, N., and Fukumoto, T., *J. Soc. Chem. Ind.* (Japan), **42**, 489 (1939).

[5] von Hippel, A., *Z. Phys.*, **67**, 707 ; **68**, 309 (1931) ; **75**, 145 (1932).

[6] Eggert, J., and Biltz, M., *Trans. Farad. Soc.*, **34**, 892 (1938).

[7] Jelley, E. E., NATURE, **139**, 631 (1937).

[8] Scheibe, G., *Kolloid. Z.*, **82**, 1 (1938).

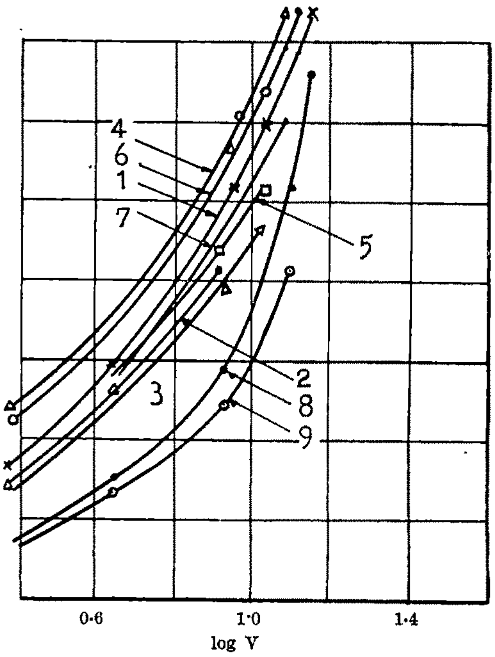
Viscosity of Suspensions and the Einstein Equation

THE Einstein equation $\eta = \eta_0 (1 + 2\cdot5\ V)$ relating the viscosity η of a suspension of solid spheres and η_0, the viscosity of the dispersion medium, V being the volume in parts of a cubic centimetre occupied by the dispersed solid, has been used as a basis for determining the molecular structure of proteins and other colloidal substances[1].

It is of interest in this connexion that the viscosity ratio η/η_0 is dependent, among other things, on temperature, the ratio being affected by the viscosity of the dispersion medium. The following data for (*a*) 16·7 per cent volume of graphite in a mineral lubricating oil and (*b*) 14·8 per cent volume kaolin in meta cresol, for example, illustrate this.

(*a*) Temp. ° C.	η	η/η_0	(*b*) Temp. ° C.	η	η/η_0
30	3·7	3·6	13·5	1·21	7·7
40	1·9	3·4	22	0·15	7·2
45	1·5	3·1	45	0·05	6·7

That the effect is not entirely due to disaggregation is indicated by using dispersion media of different viscosity. In the accompanying graphs, values of log $(\eta/\eta_0 - 1)$ and log percentage volume are plotted for powdered silica in various liquids, and it will be seen that the curves are roughly in order of the viscosity of the liquids, the viscosity ratios being least for normal hexane and greatest with glycerol. The source of the variation is presumably due to the spinning motion of the particles or their aggregates, less time being required in the thinner liquids for the dispersed phase to take up positions of streamline flow.



1, MINERAL LUBRICATING OIL ; 2, RICINOLEIC ACID ; 3, LIGHT MINERAL LUBRICATING OIL ; 4, GLYCEROL (91%) ; 5, POPPY SEED OIL ; 6, RAW LINSEED OIL ; 7, TRIACETIN ; 8, CARBON TETRACHLORIDE ; 9, NORMAL HEXANE.

It was found under isoviscometric conditions that the specific character of the dispersion medium affects the viscosity ratio ; thus, for example, with kaolin, 5 per cent volume, a viscosity ratio of 2·15 was found in a light mineral oil, but in oleic acid the ratio was 1·3 and in benzyl alcohol 1·45.

It is possible that in very dilute suspension these effects may be minimized, but in the systems examined at lower concentrations the variations were observed.

The viscosity measurements were made in a simple form of plastometer, low rates of shear being avoided.

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April 29.

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[1] "Viscosity and Molecular Structure", by H. Mark and R. Simha, NATURE, **145**, 571 (April 13, 1940).

Cohesion of Liquids

THE recent interesting letters of Profs. M. Born and R. Fürth, published in NATURE of May 11, on the strength of solids, lead me to think that experiments which I am now carrying out on the strength of liquids under hydrostatic tension may be of interest to physicists working in this field. Liquids, owing to their homogeneity and absence of rigidity, possess certain advantages over solids for the study of cohesion. In my view, measurements of the greatest tension which can be applied to liquids under various conditions have been rather neglected by physicists, particularly in recent years.

In my experiments, a form of apparatus has been devised in which a metallic bellows, closed by a needle valve, contains the gas-free liquid under test, and the possibility of inward leakage of atmospheric air is avoided by completely surrounding the bellows and valve by the same liquid. The needle valve being closed, tension is gradually applied to the liquid by slowly filling a suspended can by means of a small jet of water. The water flow is turned off the moment a sudden downward movement of the can indicates that the liquid has broken. The can is then weighed complete with the contained water, and the tension which existed in the liquid immediately prior to breaking is calculated from the known effective cross-section of the bellows.

The liquids so far examined by this method are alcohol, ether and lubricating oil. It would be premature to quote results in detail at the present stage. However, it appears that the maximum tension which the above liquids will withstand for long periods under the conditions described is simply related to their surface tensions and vapour pressures. The maximum tension increases as the temperature is lowered, and this increase can be largely explained by the changes in surface tension and vapour pressure.

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Crystal Structure of Phosphorus Pentabromide

IT has been shown[1] that phosphorus pentachloride has an ionic type of crystal structure which is tetragonal and contains $[PCl_4]^+$ and $[PCl_6]^-$ groups. Phosphorus pentabromide is entirely different in crystalline form. It is orthorhombic, and X-ray investigations give for the unit cell $a = 5{\cdot}6$, $b = 16{\cdot}9$, $c = 8{\cdot}3$ A., with four molecules per unit cell. The space group is *Pbcm* and the four phosphorus atoms are therefore necessarily equivalent crystallographically and chemically. The possibility of a structure containing two different complexes similar to those in phosphorus pentachloride does not arise in this case. It is impossible to fit in four molecules of PBr_5 of the trigonal bipyramidal form, and the appearance of the diffraction patterns is entirely unlike that of a molecular compound. Patterson and Fourier methods were used to elucidate the structure. It was found that the structure contains tetrahedral $[PBr_4]^+$ groups located so that a plane of symmetry passes through each, and the fifth bromine is present as a bromide ion removed from the phosphorus at a distance about twice that of the four covalently linked atoms. It is natural to expect the stability of the octahedral complex to diminish with increasing radius of the halogen atoms so that the change-over from the constitution $[PCl_4]^+ [PCl_6]^-$ to $[PBr_4]^+ Br^-$ is not surprising.

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April 30.

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[1] Powell, Clark and Wells, NATURE, 145, 149 (1940).

Formation of Aggregates and Structures in Dilute Solutions of Hydrogen Bentonites

A YIELD value is noticeable in hydrogen bentonites at a concentration lower than that at which thixotropy first appears. This seems to happen generally with bentonites. Some natural calcium bentonites show coacervation[1]. Coacervation of fine subfractions of a natural bentonite has been reported[2] at concentrations above the thixotropic range. Hydrogen bentonites, however, show coacervation over a wide range and even below the thixotropic range of concentrations. Near about the concentration at which yield value becomes noticeable a sharp change in several properties has been observed. The cataphoretic velocity rapidly increases and tends to a maximum. The conductivity, Λ, per gram of colloid can be calculated from the relation $\Lambda = 1000 (\lambda_c - \lambda_u)/C$, where λ_c is the specific conductivity at a concentration of C grams per litre and λ_u that of its ultra-filtrate; it passes through a minimum if plotted against C or $\sqrt{C}$.

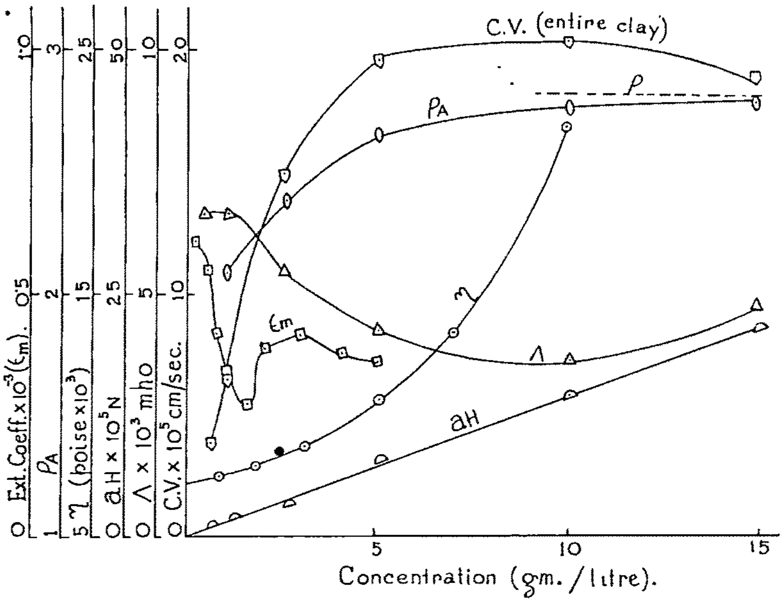
Aggregation during coagulation is often associated with an increase in the cataphoretic velocity[3]. Also the mobility of 'monomeric ions' of 'colloidal electrolytes' has been found to increase when they associate to form 'micelle ions' and pass through a maximum, whereas the equivalent conductivity of the electrolyte as a whole passes through a minimum[4]. The hydrogen ion activity of hydrogen bentonite changes almost proportionally with concentration. The total acidity calculated from the inflexion point[5] in the sodium hydroxide titration curve does not generally vary with concentration, though a variation has been observed for one subfraction of a hydrogen bentonite[6].

The conductivities per gram of colloid calculated from the relation $\Lambda' = a_H (l_H + l_{\text{coll}})/C$, where l_H and l_{coll} are the mobilities of hydrogen and 'colloid' ion respectively, are appreciably greater than Λ. The free charge per particle calculated from a_H, assuming the activity coefficient to be unity, is of the order of 500 or 1,000 electron units. Onsager's conductivity equation[7] for a similar electrolyte in true solution is inadequate to explain the form of the Λ, $\sqrt{C}$ curve.

The special features of these titration curves[5] and the discrepancy between observed and calculated conductivities per gram colloid are, however, met with in hydrogen clays and other similar colloidal systems[8] but are not of immediate interest. The sols have strong absorption. Interpretation of the measurements of extinction coefficient is difficult. The latter decreases with the concentration and passes through a minimum. Somewhat similar changes have been observed with colloidal dyes[9] and ascribed to aggregate formation. The 'true viscosity' increases with C at a rate much greater than that corresponding to a linear relationship.

Neither Einstein's equation nor Smoluchowski's modification of it can account for the high viscosity or its variation with concentration. Also the high viscosity cannot be fully accounted for by the anisometry of the particles. Hauser and LeBeau[10] observed that the apparent specific gravity, ρA, of subfractions of a natural bentonite increases with concentration and approaches a limiting value. However, ρA observed by them in the most dilute solutions is definitely less than the true specific gravity, ρ, of bentonites recorded in the literature, while ρ*A* for the higher concentrations has a definitely larger value and is also greater the finer the subfraction. Hydration cannot explain how ρ*A* can fall below ρ. We find that the limiting value of ρ*A* shows a fair agreement with the specific gravity of the material dried at 110° C. and immersed in toluene.

Air-dried hydrogen bentonite *en masse* has been observed to have the same specific gravity[11] in both water (2·248) and toluene (2·249). The diminution of density and not an increase requires an explanation. The precise manner in which this takes place has to be clarified by further experiments. However, clay minerals of the montmorillonite group show strong swelling in water as a result of the penetration of water molecules into the lattice. If the resulting free space in the lattice is not completely filled by water molecules the apparent specific gravity of the particles will decrease. It appears that with increase of concentration aggregates are first formed and then some sort of a structure develops and a yield value results.



Thixotropy comes next. Coacervation shows itself generally after the development of the yield value but may appear before or after thixotropy develops. Results of measurements obtained with a particular subfraction of a hydrogen bentonite (average effective radius about 12·5–25 mμ) are shown in the figure.

These investigations have been carried out with the aid of a grant from the Assam Oil Co., Ltd.

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April 18.

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* Research scholar appointed by the Assam Oil Co., Ltd.

[1] Private communications from Mr. A. Reid.

[2] Langmuir, *J. Chem. Phys.*, **6**, 373 (1938).

[3] Mukherjee, Chaudhuri and Ghosh, *Trans. Nat. Inst. Sci. India*, 1, No. 4, 47 (1935).

[4] Hartley, *Kolloid Z.*, **88**, 22 (1939).

[5] Mukherjee, Mitra and Mukherjee, *Trans. Nat. Inst. Sci. India*, 1, No. 10, 227 (1937).

[6] Unpublished results by Dr. R. P. Mitra and Mr. S. Roy.

[7] Onsager, *Trans. Farad. Soc.*, **23**, 341 (1927).

[8] Mukherjee, *Kolloid Z.*, **62**, 257 (1933); **63**, 36; **65**, 72.

[9] Körtüm, *Z. phys. Chem.*, B, **34**, 255 (1936).

[10] Hauser and LeBeau, *J. Phys. Chem.*, **42**, 1031 (1938).

[11] Woodman, *J. Soc. Chem. Ind.*, **51**, T, 327 (1932).

Total Energy Absorption in Biological Objects

THE total energy absorbed in a biological system when irradiated by a beam of X- or gamma-rays is a quantity of both theoretical and practical interest. The letter by Dr. Happey[1] indicates one method of attempting to solve such a problem, but it seems that the matter may be carried much further. When a beam of X- or gamma-rays is sent into a scattering medium such as a block of tissues, the distribution of radiation absorbed within the tissues may be conveniently represented by constructing 'isodose surfaces'. During the last two years we have carefully studied these surfaces, and they seem to afford the best method of attacking the total energy absorption problem. If the isodose surfaces have an axis of rotation, the volume of tissue between any two surfaces representing given dosage levels may readily be determined, so that by multiplication of volume (or more accurately mass of substance) and average dose we obtain the 'integral dose'. In this way we have studied the integral dose over a wide range of clinical conditions. An indication of the kind of results obtained is given in the accompanying table. The most striking feature is the very large variation in integral dose (always taken to the 10 per cent isodose surface) which exists between the different techniques. The results may be correlated with the very varying constitutional effects produced in the patients by the treatments.

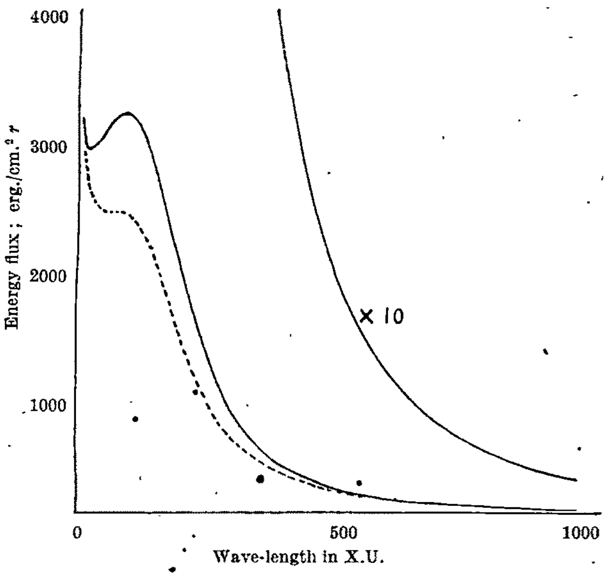
We have also developed semi-empirical formulæ very similar to those of Happey and compared the results of such calculations with the more elaborate isodose surface investigations. The table shows that although there is fair agreement between the two methods there are occasionally wide divergencies.

The problem may, however, be attacked from a third, and perhaps more interesting, point of view. From the definition of the röntgen and the known absorption coefficients of air, it is possible to calculate the total energy flux per cm.^{2} per röntgen for different wave-lengths. The results are shown in the accompanying figure. We may, therefore, calculate the total energy which flows through the surface of the body during a radiation treatment. Many examples of these energy fluxes have been investigated by us, but to fix the order of magnitude we may state that for short wave-lengths ($\lambda = 0{\cdot}01$ A. to $\lambda = 0{\cdot}1$ A.) about half a gm. cal./cm.^{2} is absorbed for the normal therapeutic dose of 6,000 *r* on the skin. It may also be shown that when one röntgen is absorbed in one gram of air approximately 85 ergs are converted into energy of electronic motion. The amount of energy converted per electron per röntgen in other materials likely to occur in living tissues has been recently investigated[2]. We may, therefore, approximately convert the integral doses into total energy absorbed in ergs and compare the results obtained with the energy flux into the body. In this way we usually find that only about one third to one half of the energy poured in reappears as absorption in the

No. of radiation	Type of radiation	Type of technique	Potential in kv.	Filter	Mean wave-length (A.)	Focal distance	Diam. of field	Gram-röntgens to 10% contour	Integral dose from formulæ
1	X-rays	'Röntgen cautery'	45	Unfiltered. Tube only	0·90	2·0 cm.	1·0 cm.	71·5	68
2	X-rays	'Contact therapy'	60	Tube only. 0·2 mm. Ni equiv.	0·33	5·0 cm.	4·0 cm.	4,200	4,950
3	X-rays	'Deep therapy'	200	1 mm. Cu.	0·12	50 cm.	10·0 cm.	96,560	95,000
4	X-rays	'Super-voltage'	400 (peak)	4 mm. Cu.	0·069	50 cm.	10·0 cm.	110,000	107,000
5	γ-rays	One gm. unit	—	1 mm. Pt equiv.	0·014	5·0 cm.	5·0 cm.	14,593	11,200
6	γ-rays	Five gm. unit	—	1·4 mm. Pt equiv.	0·013	8·2 cm.	8·0 cm.	51,587	48,420

primary beam down to the 10 per cent isodose surface, the rest being scattered outwards or absorbed in parts of the body at low dosage-rates. Preliminary calculations indicate that this result is of a reasonable order of magnitude.

These considerations would also seem to have important consequences in relation to protection problems. For example, the 'tolerance' dose is defined as 0·2 *r* per day, and we may, therefore, calculate approximately the total energy absorption for a person of a definite weight exposed for a year to this dosage-rate. It is found that the order of energy absorption per year for gamma-rays at the tolerance dosage-rate is the same as that for one moderate-sized field (10 cm. diameter) during a course of high-voltage X-ray or gamma-ray therapy giving a surface dose of 3,000 *r*. This result may be taken as a warning or an excellent example of the importance of the 'time factor'. Again, if we consider a very small biological object constructed of approximately air-like material, then the dose in röntgens is an approximate measure of the energy absorbed in it whatever the wave-length. If, however, we consider an object sufficiently large wholly to absorb the energy falling on it, then the curve also represents the total energy absorbed per röntgen per cm.^{2} of surface irradiated by a parallel beam. The energy absorbed per röntgen measured on the surface is now clearly very dependent upon the wave-length, and if there are constitutional effects depending upon the total energy absorbed in the organism, we might expect wave-length dependence.



CONTINUOUS LINE, IN AIR; BROKEN LINE, WITH BACKSCATTER.

It will be seen, for example, that a given dose of gamma-rays would correspond to a very much larger energy absorption throughout the absorbing mass than for the same dose in röntgens of longer wave-length radiations such as scattered X-rays of wave-length 200 X.U. or diagnostic X-rays. Many animals and the human body would appear to be of such a size as to provide conditions intermediate between the two extremes, the magnitude of the effect depending upon the relative size of the absorbing mass and the 'mean free path' of quanta within ($1/\mu$). Owing to the complexity of the circumstances it has not yet been possible to obtain accurate information though we have some data; but it should be realized that there is some physical basis for expecting the tolerance dose to decrease with wave-length. The classical proofs of independence of biological effect with wave-length using very small biological objects would seem to have no necessary validity for large absorbing bodies.

Finally, we have been able to compare the energy flux during normal short wave-length X-ray or gamma radiation treatment with that occurring during ultra-violet light irradiation.

The whole subject has as yet scarcely become quantitative, and much more investigation is required, but it is clear that it offers important problems in biophysics. An account giving details of the physical and mathematical investigations carried out by us during the last few months has been submitted for publication elsewhere[3].

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May 7.

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[1] Happey, F., NATURE, 145, 668 (1940).

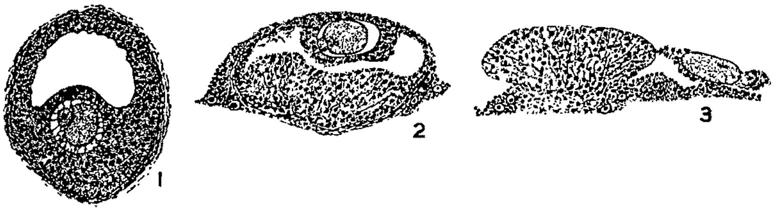
[2] Mayneord, W. V., "Reports on Progress in Physics" *Phys. Soc.*, 5, 284 (1939).

[3] Mayneord, W. V., *Brit. J. Rad.* (in the press).

Mechanism of Ovulation and Corpus Luteum Formation in Elephantulus

In the course of an examination of serial sections of close on two hundred uteri and ovaries of *Elephantulus myurus jamesoni* in our studies on the menstrual and reproductive processes of this animal, we have had the opportunity of observing all phases of follicular and luteal growth in the ovary. This was facilitated by the fact that Elephantulus sheds up to sixty ova at a time from each ovary although only one embryo develops in each uterine horn. The corpus luteum does not commence to form *after* the extrusion of the ovum from the follicle, but rather before the ovum is extruded. In fact, the corpus luteum is responsible for ovulation (see accompanying illustration, 3).

The luteinizing granulosa cells proliferate at one pole of the follicle, encroach on the follicular cavity which is gradually obliterated, and the ovum is steadily pushed out of the follicle through the superficial layers of the ovary. During the process the theca interna proliferates, is vascularized and in turn invaginates the heaped-up luteal cells. By this method the original epithelium lining the follicular cavity is everted so that the free margin of the corpus luteum represents anatomically the lining epithelium of the original cavity, which now projects from the surface of the ovary, and the attached portion is vascularized by thecal vessels which extend radially towards the expanded free margin of the newly found corpus luteum.



1, Ripe Graafian follicle; 2, Graafian follicle on the surface of the ovary, preparatory to ovulation; granulosa cells are commencing to luteinize; 3, recently ruptured follicle with attached ovum and everted corpus luteum (×c.80).

Many theories have been invoked to explain the exact mechanism of ovulation, such as the increased tension produced by the secretion of the liquor folliculi, the contractions of smooth muscle and the action of enzymes[1].

While the method of corpus luteum formation in Elephantulus is unique and is so totally different from the accepted procedure in other animals, it nevertheless negates the above-mentioned theories of ovulation.

The findings in Elephantulus substantiate the claims that ovulation is a phase in the growth process controlled by the gonadotropic hormones, since there is most convincing evidence that pre-ovulatory differentiation occurs in the granulosa cells of the follicle.

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[1] Hartman, Carl G., "Sex and Internal Secretions", pp. 629–651. Edited by Allen, Darnforth and Doisy (Williams and Wilkins, 1939).

Possible Relation between Ability to Synthesize Vitamin C and Reaction to Tubercle Bacillus

We had occasion to write the following two lists within a few days of one another and were struck by the close similarity between them :

Classification of Ability of Different Mammalia Species

(A) To synthesize vitamin C (McCollum 1939)[1].	(B) To resist infection with human and bovine tubercle bacillus (M.R.C. 1930)[2].
1. Require vitamin C in their diet (that is, are unable to synthesize vitamin C themselves): Man. Monkey. Guinea pig.	1. Susceptible to infection by both bovine and human tubercle bacillus : Man. Monkey. Guinea pig.
2. Query require vitamin C in their diets (that is, authorities are in doubt as to their ability to synthesize vitamin C) : Rabbit. Pig. Cattle Mouse.	2. Susceptible to bovine but resistant to human tubercle bacillus. Rabbit. Pig. Calf. Goat. Sheep. Horse.
3. Do not require vitamin C in their diet (that is, are known to be able to synthesize vitamin C) Dog. Rat.	3. Resistant to both bovine and human tubercle vacillus : Mouse. Dog. Rat.

We feel that this similarity is too close to be a pure coincidence and that there is possibly a relation, at present obscure, between the ability to synthesize vitamin C and the reaction to the tubercle bacillus. This is especially interesting in view of the number of papers appearing recently which suggest that the vitamin C metabolism is higher than normal in tubercular patients.

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[1] McCollum, E. V., Orent-Keiles, E., and Day, H. G., "Newer Knowledge of Nutrition" (New York: Macmillan Co., 1939).

[2] "A System of Bacteriology" (London: Medical Research Council, 1930).

Growth of Protoplasm and Nitrogen Migration in the Coleoptile of *Zea Mays*

It is generally accepted that during the growth in length of meristematic plant cells the increase of volume is principally caused by the formation of a big vacuole, whilst the protoplasm does not grow considerably. Investigations[1] on the coleoptile of *Zea Mays* disprove this view. Cytological measurements of the plasmatic content before and after the phenomenon of cell stretching show an increase of protoplasm of 1,670 per cent and more. This cannot be due to a simple swelling of the protoplasm, as during this time the protein nitrogen of the cells increases as many as 9·5 times. Therefore there is not so striking a difference between the behaviour of protoplasm in growing cells of plants and animals as is generally believed.

In the growing coleoptile considerable amounts of water-soluble and protein nitrogen migrate upwards, whilst the auxins migrate downwards. So long as the coleoptile is growing its content of total nitrogen is increasing. Only in the withering coleoptile a decrease of nitrogen does take place. But the coleoptile is not completely emptied of nitrogen before it dries. In this way every germ loses about 2 per cent of the nitrogen originally stored in the seed.

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May 9.

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[1] *Ber. Schweiz. Bot. Ges.*, 50b (1940).

Algæ in the Bed of the Dead Sea

THE presence of living micro-organisms—algæ and bacteria—in Dead Sea water was demonstrated by me some time ago.[1] It seemed, therefore, probable that life was also abundant in the sediment bed of the Dead Sea. To throw light on this point an investigation on a sample of sediment obtained from the sea bottom has been carried out.

The sediment sample was taken by means of a Fischer bottle at a point 23 km. west-south-west of the mouth of the Jordan and *c.* 8 km. off the east coast on December 28, 1939. The depth of the sea at this point is 350 m. The total salt concentration in the water near the sea bottom is 32 per cent. The specific gravity at 20° C. is 1·212. The percentage of different salt species in the sea water is as follows:

$NaCl$	9·42
KCl	1·42
$MgCl_2$	14·41
$CaCl_2$	4·78
Br	0·46

After storage for about three months at room temperature, the sample of sediment was examined microscopically for signs of life. These were abundantly in evidence. So far 17 species of algæ, living and dead, among them 4 or 5 Chlorophyceæ and 12 Diatomeæ, have been detected. The following have been identified:

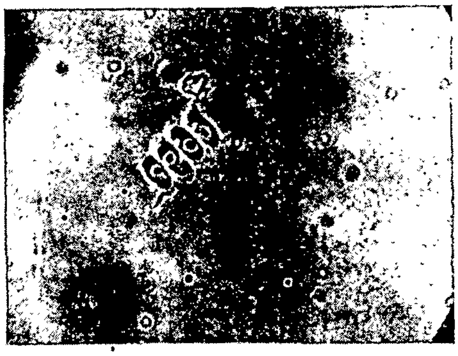

Fig. 1. × 900.

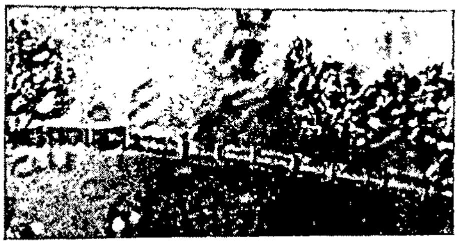

Fig. 2. × 900.

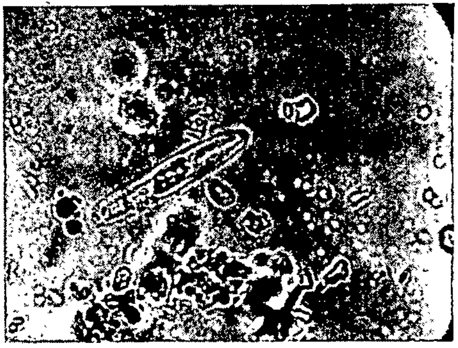

Fig. 3. × 900.

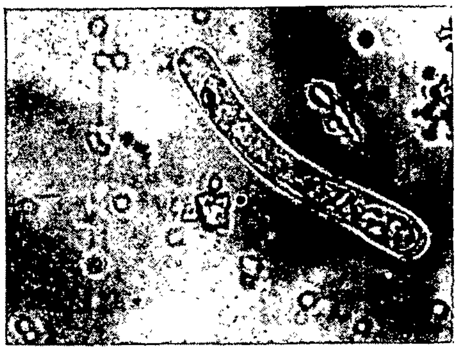

Fig. 4. × 900.

Chlorophyceæ: (1) *Scenedesmus quadricauda* (Fig. 1); (2) a filamentous alga of the order Ulothrichales (Fig. 2).

Diatomeæ: (1) Pennatæ, including Naviculoideæ (Fig. 3); (2) Centricæ, including Melosira.

A species of Chlorophyceæ most commonly observed was of an elongated type with a greenish-yellow chromatophore, occasionally seen in pairs (Fig. 4). In several diatoms the chromatophore was visible. It seems likely, therefore, that the diatoms found in the sea bed are at least in part alive.

A full description of the Dead Sea bed algæ will be published elsewhere.

Thanks are due to the Palestine Potash, Ltd., for submitting the sample and the water analysis.

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March 19.

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[1] Wilkansky, B. (Elazari-Volcani), NATURE, 138, 467 (1936). A full description will be published shortly.

Comparative Morphology and Evolutionary Trends in Trichoptera

THE internal anatomy of adult Trichoptera has been very little studied, especially on a comparative basis. A detailed attempt has been made in this direction and some interesting results have been obtained. In a study of the internal anatomy of six families of adult Trichoptera, the following significant conclusions have been drawn.

(1) There is a correlation between the structure of the systems and the habitat. It seems that the modification of Trichoptera has been associated with the invasion of poorly aerated waters as exemplified by the swift (flowing) stream-inhabiting *Rhyacophila dorsalis*, and slow stream-inhabiting *Mystacides longicornis*.

(2) Different systems in the same species do not evolve synchronously ; that is to say, there has been a differential intra-organic evolution.

(3) The trend of evolutionary development in adult Trichoptera has been towards reduction and simplification of structure, associated with a tendency towards non-feeding in the adult and the shortening of life.

It is hoped that the above results will shortly be published in detail.

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May 22.

Effect of the Severe Winter of 1939-40 on British Oyster Beds

PROF. ORTON has recently recorded[1] some details of the damage caused by the severe winter just past on the oyster beds of the Rivers Blackwater and Roach. As the result of an inspection of these and other beds during the period April 9–19, I am able to supplement the information given by him.

There is no doubt that the entire stocks of Brittany oysters (*Ostrea edulis*) relaid in the Blackwater and Roach Rivers have been destroyed. During a day's dredging on the River Roach no living Brittany oyster was found, while of the one or two per cent remaining alive in the Blackwater at the time of the survey nearly all were weak and contained mud in the mantle cavity, despite the fact that the water temperature had risen to 7·5° C. during the period between the surveys conducted by Orton and myself.

Oysters from Brittany are relaid at two other points on the East coast, namely, in the River Medway (Hoo Creek) and off Whitstable. In the Medway the mortality was 100 per cent. At Whitstable the mortality among Brittany relaid oysters was about 95 per cent and the survivors were still weak.

Brittany oysters relaid in the River Yealm, South Devon, have not suffered to the same extent, the mortality not exceeding 30 per cent, while in the Helford River, Cornwall, the losses were only slight.

Among native oysters the losses have not been so high, although the figures obtained in April were considerably higher than those recorded by Orton, showing that the losses had continued, as he had anticipated. In the Blackwater, 75–80 per cent of the native stocks have been destroyed, while in the River Roach 80 per cent of these oysters have died. In the River Colne and in Pyefleet the mortality among the stock of natives is estimated at 75 per cent and it is noticeable that here, as elsewhere, the larger oysters have suffered most severely. The survivors were still weak at the time of the survey. On the layings in the various creeks at West Mersea the mortality was somewhat variable, depending upon the amount of protection from silt driven in by easterly winds, but was nowhere less than about 50 per cent and reached 75 per cent or rather more in places.

In the River Crouch, which probably carried a larger stock of native oysters than any other river in the country, conditions were slightly better and the mortality did not exceed 50 per cent except in the upper reaches of the river. Of about a million oysters which had been collected in the storage pits when the frost set in, nearly 50 per cent have died and the survival of the remainder is doubtful.

At Whitstable native oysters have survived in considerable numbers, particularly those bred on the Whitstable Flats, and although precise figures are not yet available the mortality is not expected to reach 50 per cent. The losses among native oysters in Cornwall were slight, but the stocks were not high.

American oysters (*Ostrea virginica*) are laid down in the creeks at Brightlingsea and West Mersea, and by Christmas the stocks remaining on the layings were small ; the losses experienced vary between 25 and 50 per cent. Portuguese oysters (*Ostrea angulata*) are laid down at Brightlingsea, West Mersea and in the River Medway. The mortality varies somewhat from creek to creek. Estimates of the losses vary from 35 to 50 per cent.

Oysters bred on tiles in the experiment tanks at Conway, North Wales[2], and planted out in the Menai Straits, in situations where they are uncovered at spring tides, have suffered very little loss, despite several weeks of severe frost, and air temperatures down to −12° C. Similar tank-bred oysters in the River Yealm, South Devon, have also survived the winter without serious losses.

During the course of the survey of East coast oyster beds no evidence was found of any mortality among the slipper limpets (*Crepidula fornicata*) infesting these beds, other than a report of considerable deaths in the very shallow waters of Hoo Creek, River Medway. Elsewhere the clumps of slipper limpets were all tightly joined and no recently emptied shells were obtained in the dredge. The general weakness noted by Orton was nowhere apparent.

Recent samples of *Urosalpinx cinerea*, the American oyster drill, from the East coast beds contain only an occasional empty shell and show definitely that this pest has once again survived a severe winter without loss[3]. No living specimens of *Ocinebra* (*Murex*) *erinacea*, the British drill, have been noted in recent samples of drills from the River Blackwater, as contrasted with approximately 9 per cent in similar samples collected a year ago. It appears as if Urosalpinx has now almost completely replaced Ocinebra on the East coast beds.

H. A. COLE.

Fisheries Experiment Station,
Conway, N. Wales. May 20.

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[1] Orton, J. H., NATURE, 145, 708 (1940).

[2] Cole, H. A., *Min. Agric. and Fish., Fish Invest.*, Ser. 2, 15, 4 (1939).

[3] Orton, J. H., and Lewis, H. M., *J. Mar. Biol. Assoc.*, 17, 2 (1931).

Effect of X-Rays on Carboxypeptidase

In a recent review[1] of the biological action of X- and gamma-rays, the conclusion is reached that only enormous doses of X-rays have an appreciable destructive effect on enzymes and that enzymes therefore play no important part in explaining the effect of X-rays on living tissues.

I have examined the effect of X-rays on crystallized carboxypeptidase[2] (substrate : edestine) with the following results.

The percentage destruction is a function of the concentration of the enzyme for a given dose of radiation. A definite amount of radiation energy absorbed corresponds to a constant amount of enzyme destroyed. In consequence, the percentage destruction increases as the concentration of the enzyme decreases : for example, if the concentration of the enzyme is 0·0080 $(\text{C.P.u})^{\text{PDE}}$ per ml., 50,000 r. will destroy 21 per cent, 150,000 r. 50 per cent and 400,000 r. 65 per cent. However, if the concentration is 340 times lower, then 50 r. will destroy 29 per cent, 140 r. 50 per cent and 400 r. 70 per cent.

This shows that the concentration of enzymes has to be taken into account if statements regarding their radio-sensitivity are made. It shows, furthermore, that X-rays have a qualitatively uniform effect on the enzyme over the whole range of doses, from very small doses to doses a thousand times as large. This point is of importance in view of the opinion held by many that small doses act in an essentially different way from big doses.

Finally, I have found that X-rays have no effect at all on the enzyme carboxypeptidase when it is combined with its substrate during irradiation, whereas the enzyme simultaneously irradiated without its substrate showed 85 per cent destruction.

Details of the work will be published elsewhere.

W. M. Dale.

Christie Hospital and
Holt Radium Institute,
Manchester.
May 15.

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[1] Scott, C. M., Medical Research Council, Special Report Series No. 223 (1937).

[2] Anson, M. L., *J. Gen. Physiol.*, **20**, 781 (1936–37).

"Books in War-Time"[1]

In the libraries books are divided into two great classes : fiction and non-fiction. Nine tenths of the fiction published is of such poor quality that it could well be spared in war-time, whereas publications on non-fiction nearly always contain something of value. Good fiction is valuable and should not be discouraged, but a reduction of the present enormous volume of bad novels would give the few good ones a better chance of recognition. The Government might therefore consider whether the allotment of paper for fiction might not be cut by 90 per cent whilst allowing full supplies for non-fiction, which would be sufficiently handicapped by rising prices.

Arthur Marshall.

The Athenæum,
Pall Mall, S.W.1.
May 23.

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[1] Nature, 145, 719 (1940).

Points from Foregoing Letters

S. E. Sheppard, R. H. Lambert and R. D. Walker find the necessary and sufficient conditions for optical sensitizing of silver halides by dyes to be : (1) planar configuration of dye molecule ; (2) edge-on adsorption of dye ion or dipole ; molecular plane orthogonal to a (110) plane of silver-halide crystal ; (3) electronic transition in dye ion or molecule on absorption of light polarized in azimuth, defined by (1) and (2).

A new apparatus has been used by R. S. Vincent for measurements on the cohesion of liquids. A metallic bellows is employed for applying tension to the liquids, and it has been found that the maximum tension which can be applied is simply related to surface tension and vapour pressure, and that the effect of temperature can be largely explained by the changes in these properties.

H. M. Powell and D. Clark show that phosphorus pentabromide has a crystal structure entirely different from the pentachloride. A constitution analogous to $[\text{PCl}_4]^+$ $[\text{PCl}_6]^-$ is no longer stable owing to the larger radius of the bromine but an ionic structure is formed containing $[\text{PBr}_4]^+$ and Br^- ions.

A study by J. N. Mukherjee and N. C. Sen Gupta of the variation of several properties of dilute solutions of hydrogen bentonites with concentration suggests that aggregate formation in bentonites begins at a very low concentration. At a somewhat higher concentration these aggregates form some sort of a structure and a yield value develops.

The total energy absorption of biological objects subjected to X- or gamma-rays has been investigated by the construction of 'isodose surfaces' for the tissue. W. V. Mayneord describes results that have been obtained.

B. Elazari-Volcani reports that he has found seventeen species of algæ in material obtained from sediment from the bottom of the Dead Sea. Photomicrographs are submitted.

P. J. Deoras, working on the internal anatomy of six families of adult Trichoptera, finds that the trend of evolutionary development has been towards reduction and simplification of structure associated with a tendency towards non-feeding in the adult and the shortening of life. Further, there has been a marked differential intra-organic evolution.

As the result of a survey of the damage caused by the severe winter just passed on British oyster beds, H. A. Cole has found that virtually the entire stocks of Brittany relaid oysters (*Ostrea edulis*) on the Essex and Kent beds, probably amounting to thirty millions all told, have been destroyed, while the stocks of native oysters have been reduced by about 75 per cent.

W. M. Dale has exposed solutions of the crystalline enzyme carboxypeptidase to X-radiation. He finds that the percentage destruction of the enzyme is a function of its concentration, increasing as the concentration decreases.

RESEARCH ITEMS

Teeth of Finnish Lapps

A DISCUSSION by Helen Mellanby (*Brit. Med. J.*, April 27, 1940) of dental deformation and caries among Finnish Lapps, and their relation to changes which have taken place in the national diet, is based upon observation of 1,253 teeth of seventy children between two and fourteen years of age, undertaken in June 1939. The teeth are charted for hypoplasia and caries. The teeth of both Inari and Skoltje Lapp children are of very imperfect structure. Only 25 per cent of the deciduous teeth, and in the permanent teeth only 6·7 per cent, were of good or normal structure; and even these figures may be too high in view of allowances for attrition. As might be anticipated from the poorness of structure, caries is rampant. All children over four years of age were affected, and out of the total of seventy only three were caries-free. Of deciduous teeth 55·3 per cent and of permanent teeth 44·5 per cent were carious. Among Eskimos of East Greenland, only 2–4 per cent of the deciduous teeth and 1–1·4 per cent of the permanent teeth in the ages 0–13 years were affected. In the cranial material, only a proportion of the teeth remained. Nevertheless, comparative examination shows a decided deterioration in structure and increase in carious affection in the modern material. There is evidence to suggest that deterioration set in about 1900 when Finns began to immigrate in numbers. Further, in the last century or more the diet of the Lapps has changed. Like that of the 'uncivilized' Eskimos, it was almost entirely carnivorous, a low calcium intake being made good by chewing bones. In the modern dietary there are important differences, notably cheap margarine, coffee, oatmeal, sugar and potatoes. Cereals are consumed in large quantities during the winter. If allowance is made for the anti-calcifying effect of a high cereal content of the diet, it may account for a deterioration in tooth structure which is correlated with a greater liability to caries.

Fishes of the John Murray Expedition

A MAGNIFICENT collection of fishes is described by J. R. Norman (John Murray Expedition 1933–34. *Sci. Rep.*, **17**, No. 1. Fishes. British Museum (Natural History), 1939). These were obtained from the Red Sea, Gulf of Aden, South Arabian coast, Gulf of Oman, Arabian Sea and in the Zanzibar and Maldive areas, chiefly from regions largely unexplored for deeper water fishes, and, as was to be expected, there are many which are new to science (28) and new to the British Museum collection (56). 276 species are represented altogether. Some of these deep-water species from the Zanzibar region and the Gulf of Aden were hitherto only known from the Philippines and adjacent seas, but the author is convinced that more extensive collecting in the intervening areas of the Indian Ocean would show that most of these forms have a wide range in this part of the world. Among the interesting finds is an egg capsule from the depth of 1,061–1,080 metres, of one of the Chimæridæ, probably Harriotta. A synopsis of the Oceanic genera of the Brotulidæ is included in the report and a key to these.

Biology of Rubus Aphides

G. H. L. DICKER (*J. Pom. and Hort. Sci.*, **18**, 1; 1940) has carried out a detailed investigation into the biology and morphology of four important pests of Rubus, *Macrosiphum rubiellum* Theo., *M. rubifolium* Theo., *Amphorophora rubi* (Kalt) and *Aphis idæi* van der Goot. Field observations were made to elucidate the life-histories, and statistical data obtained on seasonal fluctuations of the populations. It appears that Coccinelid larvæ are responsible for the decline in populations during August. A comprehensive list of host plants is given for each of the common aphides, and consideration of their origin shows that there is often a close correlation between the genetical constitution of the host and the species of aphides breeding on it. Thus, *M. rubiellum* shows definite preference for species of blackberry or blackberry crosses, whilst the raspberry and its hybrids are avoided. This selectivity narrows down the field of investigation of virus diseases transmitted by aphides. Notes are given on six other species of aphides recorded on Rubus in Great Britain, and one unnamed species related to *Aphis Urticaria* Kalt.

Spores of Bryophyta

Miss Knox has added to her experience of spore types by a survey of Bryophyte spores (*Trans. and Proc. Bot. Soc., Edin.*, **32**; 1939), with the view of identifying fossil spores in coal. The survey shows great variety among liverwort spores, as compared with considerable uniformity among those of mosses. The liverwort spores have a wide range in size and also in the type of wall sculpturing, and this is especially striking in the case of certain genera which are also characterized by other features of form and structure, such as Frullania. Evidence from various sources suggests that Bryophyta had reached a considerable degree of specialization by Carboniferous times, and it is probable that many of the spores found in the Fife coals may be of this origin. Though the author would not suggest that specific or even generic significance should be attached to them, the broad comparisons of spore types suggest that many of the living groups of Bryophyta were represented at that time. Certain characteristic spore forms, such as those of Frullania, Mastigolejeunia, Grimaldia, Targionia, and, among mosses, Breutelia, have not been recognized from the coals, whilst types closely resembling species of Anthoceros, Riccia, Moerkia and Fossombronia are present.

A Rhododendron Complex

THE beautiful *Rhododendron sanguineum*, regarded as a single species at the beginning of this century, has now become a taxonomic incubus of very numerous, intergrading forms. Activities of plant collectors in western China have contributed greatly to horticultural beauty, but have added to the difficulties of the plant systematist. John M. Cowan, in a most useful evaluation of the Sanguineum subseries (*Notes Roy. Bot. Gard. Edin.*, **20**, No. 97, pp. 55–91; February 1940), has shown that there are eight recognizable species, comprising 43 sub-species, in the group. The key and descriptions which are given should provide an adequate taxonomic framework, and should bring order to this formerly chaotic section of botanical classification. Considerable restraint has been practised by the author to avoid unpractical 'splitting', and his conclusions are based upon the examination of several thousand living plants and herbarium specimens.

Position of Chiasmata

K. Mather (*J. Genetics*, 39, 205–223; 1940) has continued his studies on the determination of the position of crossing-over. The ratio of differential-interference-distances, that is, the distance between the centromere and the proximal chiasma and between the proximal and second chiasma may be used to describe the distribution of the chiasmata on the chromosome. Analysis of the cytological results in several species shows that the agreement between this ratio and the observed positions of chiasmata at metaphase and anaphase is close. Therefore the author suggests that the position of chiasmata at metaphase is the same as at chiasma formation; terminalization is an all or none process. Either all chiasmata terminalize or only the most distal ones move to the ends without reducing the frequency of chiasmata. This hypothesis therefore implies that chiasmata (*a*) tend to have determinate positions, and (*b*) no detectable change in these positions occurs after formation, unless potentially complete terminalization is also present.

Incompatibility in Cosmos

T. M. Little, J. H. Kantor and B. A. Robinson (*Genetics*, 25, 150–156; 1940) show that *Cosmos bifurcatus* is completely self-sterile. As the result of intercrossing 25 plants they have found three intrasterile interfertile groups with indications of two further groups. The behaviour is accounted for on East's hypothesis of incompatibility factors. The genetic constitution of the three groups is s_1s_3, s_1s_2, s_2s_3, while a further group contains s_4.

Pollination in Maize

Mangelsdorf had found that a gene sp_1 gives rise to small pollen grains. Only about 1 per cent of these achieve fertilization in competition with normal-sized pollen grains, but are fully functional when the normal pollen is eliminated by screening through sieves. W. R. Singleton (*Proc. Nat. Acad. Sci.*, 26, 102–104; 1940) found that when the maize strains Purdue 39 and Connecticut 81 were crossed with heterozygous $\mathrm{SuSp}_1/\mathrm{susp}_1$ plants, 39 per cent and 17 per cent *su* seeds were produced although the cross-over percentage between *su* and sp_1 is 6. Further breeding confirmed that in these crosses the small pollen grains carrying sp_1 had functioned. The inbred strains Purdue 39 and Connecticut 81 have greatly increased the functioning of the small pollen grains. The reasons are unknown.

Earthquakes of Missouri

Ross R. Heinrich has examined lists of earthquakes of Missouri and states that most of these earthquakes originate in more or less definite seismic districts (*Trans. Amer. Geophys. Union*, 1938). Six such districts are suggested for Missouri; they are the New Madrid, St. Mary's, St. Louis, Hannibal, Springfield, and north-west Missouri seismic districts. Some of the earthquakes which have been felt in Missouri have apparently originated in seismic areas outside the State boundaries. Four such are the Centralia and Harrisburg districts in Illinois, the Anna district in Ohio, and the Kansas-Nebraska Nemaha Belt. About 85 per cent of all the seismicity of Missouri origin comes from two seismic areas; about 60 per cent from the New Madrid area, and about 25 per cent from the St. Mary's Fault Region. A tabulation of the earthquakes by intensities indicates that most of the activity of strong intensities also seems to originate in the south-eastern Missouri area, although only about 7½ per cent of the total earthquakes recorded since the New Madrid series have been strong enough to endanger life.

Ionization Constants of Weak Acids

A new method of calculating ionization constants of weak acids from conductance (Λ) measurements (B. Saxton and L. S. Darken, *J. Amer. Chem. Soc.*, 62, 846; 1940) depends on the following procedure. The degree of dissociation is $\alpha = \Lambda/\Lambda_\infty$, where Λ_∞ = conductance of completely dissociated acid at the same ionic concentration. Then $k = \alpha^2 c/(1-\alpha) = c_i^2/c_u$, where k is the mass action constant, c is total concentration, c_i and c_u are ionic concentration and concentration of undissociated acid. Now $\gamma^2 k = K$, where γ is mean ionic activity coefficient and K is thermodynamic equilibrium constant. The Debye–Hückel equation gives $\log \gamma = -A\sqrt{c_i}$, where A is a constant. Hence $\log K = \log k - 2A\sqrt{c_i}$. K is found by extrapolating to infinite dilution a plot of $\log k - 2A\sqrt{c_i}$ against c_u, this being found empirically to be linear up to a concentration of almost 1 *m*. The values of K at 25° for cyanoacetic, formic and butyric acids are calculated.

Reality of Periodicities

The controversy as to the reality of the periodicities found by Fourier analysis of the observations of the solar constant (Abbot, *Smithsonian Misc. Coll.*, 94, No. 10, 1935; Paranjpe, *Quart. J. Roy. Met. Soc.*, 64, 459, 1938; Sterne, *Proc. Nat. Acad. Sci.*, 25, 559, 1939) has been carried a stage further by Dr. H. R. Hulme (*Observatory*, 63, 101; 1940), who approaches the subject from the statistical point of view. Hulme develops a test which, when applied to the amplitudes found for the periodicities, decides whether or not they are small enough to have arisen from statistical fluctuations. He points out that care must be taken that the observations are independent in the sense that the value of any one is unconnected with the values of neighbouring ones; this is conspicuously not the case with the 10-day means published by Abbot. It is found that random fluctuations active for a time comparable with a quarter of the length of the period in question are quite capable of producing illusory periodicities of the amplitudes actually found by Abbot for all his periodic variations. Sterne's method of assessing the reality of the periodicities by calculating the probable errors of their amplitudes also requires independence amongst the observations for its correct application; and Hulme regards his results as indicating not that the periodicities are real but that the fluctuations persist over a number of 10-day intervals. This is physically quite understandable, and such effects can evidently produce 'periodicities' of the observed order of magnitude. It is concluded that the periodicities should not be regarded as real until the more stringent test of successful prediction has been passed.

THE ROYAL OBSERVATORY, GREENWICH

ANNUAL REPORT OF THE ASTRONOMER ROYAL

THE annual report of the work of the Royal Observatory, Greenwich for the year ending May 1, 1940, was presented by the Astronomer Royal to the Board of Visitors on June 1. The following are among the chief items of the report.

Reversible Transit Circle. The observations for providing the foundations of a system of right ascensions have been continued. More than 3,500 transits were observed during the year besides a large number of observations for determining the collimation, level and azimuth of the instrument. The level error has proved to be subject to rapid diurnal variations due to changes of temperature and direction of wind. Experiments are being made to reduce these fluctuations to a minimum. Observations for the errors of the divisions of the fixed circle are progressing; already to date some 180,000 individual microscope readings have been made.

Small Transit Instrument. A small reversible transit instrument made by Cooke, Troughton and Simms has been purchased from the Crown Agents for the Colonies. The instrument is of more modern design than the small transit instruments made in 1874 hitherto in use at the Observatory for time determinations. It is hoped that observations made on the same night with (1) the new instrument, (2) the small transit in current use, (3) the large reversible transit circle, will give useful information concerning fluctuating errors of instrumental origin.

Total Eclipse of the Sun on October 1, 1940. An expedition from Great Britain had been planned to observe this eclipse in South Africa. On the outbreak of war, the plans for the Royal Observatory expedition were cancelled, but a part of the equipment, together with spectrographic instruments from the Solar Physics Observatory, Cambridge, has been sent to South Africa for use by a combined expedition from the Royal Observatory, Cape of Good Hope, and the Union Observatory, Johannesburg.

The Greenwich Equatorials. (*a*) 28-inch refractor, (*b*) 26-inch refractor, (*c*) 36-inch reflector (Yapp). Work on both (*a*) and (*b*) ceased on September 1–2, when the object glasses of the instruments were dismounted for safety. Up to that date, however, 402 plates suitable for parallax measurements had been taken with (*b*). Work with the slit-spectrograph on the Yapp reflector has been continued, and 49 ultra-violet spectra of 35 *F* to *M*-type giant stars have been obtained to test the possibility of the presence of high-temperature companions to those stars that are spectroscopic binaries.

Observations of Eros. The discussion of the material obtained at the 1931 opposition already to hand is in progress. It is clear that the final value of the solar parallax will be nearer 8·79″ than 8·80″, the latter value being that adopted in the *Nautical Almanac* and other natural ephemerides.

Solar Observations. The downward trend of the present 11-year cycle after a very high maximum in 1937–38 seems now established, although the sun has shown considerable activity throughout the year. Three of the numerous groups of sunspots recorded equalled or exceeded 2,000 millionths of the sun's hemisphere at their maximum development. The relationship between bright chromospheric eruptions and magnetic storms has been studied at Greenwich during the past year.

Time Service. Astronomical determinations of time were made on 121 nights with the small reversible transit. Star places based on the FK3 Catalogue have been used in the reductions since January 1. The universal adoption for the time determinations of the same fundamental system of star places will make the times determined at different observatories more directly comparable than hitherto. The principle of employing a 'mean clock' has been continued. Six Shortt clocks normally comprise this mean clock.

The quartz crystal controlled oscillator clock is running satisfactorily, but with rather a large rate, and the performance is not as good as it should be. At the completion of the present run, it may be necessary to have a fresh crystal cut; and the opportunity will be taken to use a fundamental frequency of 100 kilocycles per mean solar second instead of per mean sidereal second as at present. The usual service of rhythmic time signals radiated by the Post Office has been maintained. For about two months short-wave transmission was used. The B.B.C. six dots and hourly signals for controlling the 'talking clock' have also been transmitted regularly.

Nautical Almanac Office. The work of the Office has been mainly devoted to the routine calculation and proof reading involved in the preparation and publication of (1) the *Nautical Almanac,* (2) the *Abridged Nautical Almanac,* (3) the *Air Almanac,* (4) the *Astronomical Navigation Tables,* and for the first year (5) the *Apparent Places of Fundamental Stars.* Surveying this large output of material, the report adds that the Office is now responsible annually for the calculation and publication of about 5,500 large octavo pages of figures; there is probably no other institution of similar size that approaches this output.

Magnetic and Meteorological Observations. The variations of declination, horizontal force and vertical force have been continuously recorded photographically throughout the year at Abinger, absolute observations being made every weekday. The La Cour magnetographs installed during 1937–38 continue to give very satisfactory results. During the year, 30 magnetic storms were recorded of which 7 were 'great' storms. The disturbance on March 24 ranks among the greatest storms of the past ninety years.

Routine meteorology was commenced at Greenwich on November 9, 1840, and the Meteorological Department has thus now entered the hundredth year of its existence. The mean temperature for the past year was 49·1° F. (0·4° lower than the average of seventy-five years, 1841–1915). The highest temperature in the shade was 85·2° on June 7; the lowest, 12·4°, on January 20. Temperatures of freezing point or below were recorded on 66 days, of which 27 were in January. The total rainfall was 30·23 inches, which is 5·99 inches greater than the average.

The Astronomer Royal concluded his report as follows:

"In last year's Report, reference was made to the deterioration of the conditions for astronomical observations at Greenwich and for the urgent need for the Observatory to be removed to a site where the conditions are favourable. At the same time the increasing magnetic disturbance at Abinger caused by the development of electric traction requires the removal of the magnetic observations to a site remote from railways, if high precision in the observations is to be attained and if the Observatory is to be secure for the future against further developments in railway electrification. A number of possible sites, both for the astronomical and for the magnetic observations, were examined during the year. The further consideration of the plans for the removal to new sites of the astronomical and magnetic observations has necessarily had to be deferred until after the conclusion of the War.

"The further improvement in accuracy of the time service provided by the Observatory has been under consideration. For purposes where high precision is needed, corrections to the time signals are published at approximately monthly intervals, after the errors of the mean clock have been satisfactorily determined from a large number of observations. The great developments in recent years in precision frequency standards and in their use have created a need, which is extending rapidly, for time signals of such precision that an interval of 24 hours can be measured to an accuracy of one thousandth of a second, without the application of corrections published after a considerable interval. This precision is not attainable with pendulum clocks, which are less accurate than the precision frequency standards themselves. The installation of a battery of quartz crystal oscillator clocks of the highest precision is required, in order that the frequency stability of modern frequency standards may be satisfactorily controlled. Conferences on this subject have been held with the Radio Section of the General Post Office and the Research Department of the British Broadcasting Corporation. The help and collaboration of these bodies and also of the National Physical Laboratory are greatly appreciated and should go far towards enabling a satisfactory scheme to be drawn up."

THE PHYLOGENY OF MAN

PROF. W. E. LE GROS CLARK, discussing recent additions to evidence bearing on the phylogeny of man (*Biol. Reviews*, 15, 2, 1940), begins by passing in review the fossil man-like apes, commencing with the Eocene Tarsioids and the Anthropoidea, of which the earliest representative is Parapithecus from the Oligocene of Egypt. It has now become evident that at the beginning of the Miocene the main groups of the anthropoid apes which exist to-day were already undergoing separately their evolutionary definition. It is probable that the human line of descent became first differentiated at this period and that the initial appearance of the Hominidæ is to be sought in the palæontological records of this period.

The evidence for the fossil man-like apes, the Dryopithecidæ, though widespread, consists almost entirely of teeth. Nevertheless, it points to the existence of some twenty to thirty different species, indicating that differentiation from generalized ancestors had already begun. Some of these species already show marked resemblance in dentition to man, while others approximate to the orang. In the Brahmapithecus and Ramapithecus discovered in India the resemblance to man is even more emphatically marked—so much so, indeed, that question has been raised as to the propriety of including Ramapithecus in the Simiidæ rather than the Hominidæ. A comparison with the Pleistocene apes of South Africa, of which portions of the skull are available, leaves no doubt as to their Simian status.

The evidence relating to the Miocene apes, then, suggests that they may have included among their number the direct ancestry of man. The only evidence apart from teeth, relating to the Dryopithecine groups, consists of a femur and shaft of a humerus of somewhat uncertain identification. If as is probable they are to be accepted as belonging to Dryopithecus they suggest that Dryopithecus was a 'ground-ape'; and there is every reason to believe that the human line took its origin from a form adapted to a terrestrial life.

Of the extinct man-like fossil apes of South Africa, while there can be no reasonable doubt of the human characters of the milk dentition and palate of Australopithecus, the main difficulty of interpretation lies in the attempt to assess the characters of the adult from an immature individual. Of the recently discovered Paranthropus and Plesianthropus of R. Broom it may be accepted as an established fact that the teeth and palate in several respects are more human than those of any of the living anthropoid apes. The geological and faunal evidence alike debar them as too recent to stand in the direct line of human descent, but on the view that they derive from a dryopithecid ancestry of Miocene date, they support the conclusion that the dryopithecid stock was endowed with a potentiality of evolutionary development in the direction of the Hominidæ so far as teeth and palate are concerned.

Turning to the ape-like men, the recently discovered examples of Pithecanthropus, and especially the early infantile skull from Modjokerto, with which are here included the fossils from Choukoutien referred to the genus Sinanthropus, have served to confirm the Hominid status of the Pithecanthropus group. Despite many primitive features of the skull, brain and dentition, the limb bones are closely comparable with those of modern man. If the modern characters of the human limbs had already been acquired so early as the beginning of Pleistocene times, the point of divergence of the Hominidæ from the Simiidæ must have been correspondingly more remote.

The evolutionary origin of the Pithecanthropus group is entirely conjectural. Presumably it is derived from a dryopithecine ancestry; but here there is a conspicuous gap in the palæontological record.

In the classical examples of Neanderthal man, the skeleton shows the development of a number of somewhat specialized characters from which it is inferred that the type could scarcely have given rise to *Homo sapiens*. As no transition types of later date have been found, it is legitimate to assume that Neanderthal man became extinct. It is significant that typical Neanderthal forms belong to the later phase of the period, whereas the remains belonging to the earlier part of the Mousterian epoch, such as, for example, those found at Krapina in Croatia, are less typically Neanderthaloid. This agrees with the occurrence of pre-Mousterian types (for example, Ehringsdorf, Steinheim, Swanscombe) which show a close resemblance to *Homo sapiens*. There can be little doubt that they were the precursors of modern man.

The Pithecanthropus group then almost certainly provided the basis for the development of later types of man. Of these, one is represented by the rather specialized Neanderthal type of later Mousterian date—an aberrant line—and a second by types of early Mousterian and pre-Mousterian date which were less distinctively Neanderthaloid and more akin in their anatomical features to *Homo sapiens*.

DEVELOPMENTS IN ELECTRIC SURGE RECORDING

IN 1933 a considerable amount of investigation had already taken place, chiefly outside Great Britain, with the view of determining, by means of special devices called klydonographs, the effects of lightning discharges upon overhead lines. The klydonograph is an instrument in which an electric discharge takes place on to a photographic plate or film, the resulting impression affording a record of the characteristics of the discharge. The advent of the National Grid in Great Britain stimulated interest in the subject. Whilst it was seen that the published information from various countries could be usefully applied, it was also realized that, as the results were dependent on so many variables, this needed great care, and that a similar and independent investigation could with advantage be carried out in Britain.

This was undertaken by the British Electrical and Allied Industries Research Association, with the co-operation of the Central Electricity Board and the Yorkshire Electric Power Company. The complete investigation included the use of a high-voltage cathode ray oscillograph and magnetic links in addition in continuously recording klydonographs, but only the last mentioned are to be considered here. It was agreed that these instruments could not be regarded as accurate peak surge voltmeters, but that they were capable of indicating the approximate magnitudes, polarities and times of occurrence of voltage surges.

The investigation was begun in 1933, on an 11 kv. line owned by the Yorkshire Electric Power Co. Three klydonographs were coupled to the line by means of concentric-cylinder type capacitance 'potential-dividers'. It was soon found out that the klydonographs were not suitable for unattended use, and new ones containing many improvements were developed. Progressive elimination of defects resulted in trustworthy and satisfactory operation by May 1937, since when no noteworthy trouble has been experienced.

On April 5 J. L. Candler read a paper before the Institution of Electrical Engineers on developments in surge recording by means of the klydonograph. This paper is based on the E.R.A. report Ref. S/T 26, and is mainly concerned with the instruments and their auxiliaries. The principle of operation of the klydonograph is fairly simple. A high-voltage electrode is placed in front of and touching a photographic film. The momentary application of a high voltage across the electrode will produce a distinctive figure on the film after development. This figure is known as a photographic Lichtenburg figure or klydonogram, and from its size and type certain features of the voltage causing it can be deduced. By causing the film to slide between the electrodes at a known rate, the time of occurrence of the surge can be estimated. Generally two films and two pairs of electrodes are used. By comparing the two concurrent figures the polarity of the voltage producing them is definitely determined.

The complete instrument consists essentially of three parts: (1) a light-proof box containing the spools of unused films, the electrode system and the feed-control sprocket wheels; (2) a smaller light-proof box, containing spools on to which the used film is wound; and (3) a compartment containing two clock-work motors. Hundred foot reels of 35 mm. film are used and the travel rate is 1 inch an hour. Thus the films last for about seven weeks, but provision is made for cutting off the used film when desired, and two interchangeable take-up boxes are provided for each instrument.

In the latest type many improvements have been introduced and little trouble is now experienced. It is essential that in making tests on klydonographs the conditions should stimulate practical conditions as nearly as possible. For this reason a test hut was erected in the field behind the laboratory building. The requisite voltage is applied by a transformer either directly or through the potential divider. Experience since 1937 indicates that mechanically the devices have attained a very high standard of perfection, and that electrically the performance cannot be improved further with this type of instrument.

No surges considered to be due to lightning were recorded on the Rayleigh-Southend line, on the lines in South Scotland or at the (G.E.B.) Creekmouth transforming station. Recording on the Rotherham–Doncaster line and the Thornhill–Barugh line each yielded fifteen. Surges due to switching were numerous, but they are usually uni-directional and are approximately equally divided between the two polarities and limited to not more than twice the normal voltage.

MECHANISM OF PHOTOSYNTHESIS

IN a recent article (*New Phytol.*, 39, 33; 1940) K. Wohl has presented a notable addition to the literature on the kinetics of photosynthesis in green plants, in which a model is put forward based largely on the results of Emerson, Warburg, and their collaborators. Assuming that the light-sensitive reaction requires 4 quanta/mol. carbon dioxide, as first demonstrated by Warburg and Negelein, the author suggests the following type of reaction:

$$\underbrace{X_0 \xrightarrow{h\nu} X_1 \xrightarrow{h\nu} X_2 \xrightarrow{h\nu} X_3 \xrightarrow{h\nu} X_4 \xrightarrow{-O_2-CH_2O} X_0}_{\uparrow \qquad\qquad\qquad +H_2O + CO_2} \quad . \quad (1)$$

Recent work on quantum efficiency is later reviewed in the paper. The high value of this efficiency and the shape of the rate/light-intensity curve indicate that none of the intermediate photoproducts is lost and that X_4 is also produced in an irreversible way. The carbon dioxide is therefore considered attached to a 'reducing centre' which is coupled, in an energetic respect, to a number of chlorophyll molecules. Absorbed quanta may then pass to the reducing centre which, together with its associated chlorophyll, may be referred to as a *functional* photosynthetic unit. Considerations are put forward which support the existence of such a unit, and a comparison is made with the *numerical* unit of Emerson and Arnold. Figures are presented both for the *functional* and the *numerical* units in a number of plants, calculated from experiments in continuous and in flashing light, and both kinetic and optical models are set up.

As regards the sequence of events figured in (1), experiments in flashing light indicate that the four light processes occur successively with no prolonged dark reaction between. The Blackman reaction $X_4 \rightarrow X_0$, unlike most physiological reactions, deviates widely from the simple Arrhenius reaction. One explanation is that the Blackman reaction occurs in a number of steps of reaction time τ_1, τ_2, τ_3. . . . Taking two reactions only, for simplicity, τ_1 is shown to belong to a reaction of high activation energy and is several orders of magnitude smaller than τ_2 which is coupled to a low activation energy. The two reactions are therefore of entirely different types. From the calculated values of $\tau_1^{(0)}$ and $\tau_2^{(0)}$ (hypothetical reaction times at infinitely high temperatures) the author shows that τ_1 relates to a monomolecular reaction and τ_2 to a bimolecular. The calculated value $1/\tau_1^{(0)}$ surpasses the theoretical figure even for a monomolecular reaction. This is accounted for by the introduction of an entropy factor $T\Delta S$, replacing the activation energy A_1 by the free energy $A_1 - T\Delta S$ in Arrhenius's equation. This gives a figure of the correct order of magnitude only if a considerable number of atomic bonds are broken during the reaction period τ_1.

It is suggested that at least six such breakages occur and that the six CH_2O groups produced combine immediately to, for example, a hexose. These six groups must be produced successively at the same reducing centre, and photosynthesis would then be a 24-quanta process. The bimolecular reaction is taken to be the formation of an oxygen molecule. Ninety-three references are given.

RAIN FOREST OF SOUTHERN NIGERIA

DR. P. W. RICHARDS, of the Botany School, Cambridge, in a recent paper, states that it forms the first part of the results of the Cambridge Botanical Expedition to Nigeria and it aims at being a description of a typical region of the West African Rain Forest—a chief object being to compare the rain forest of this area with those previously studied in British Guiana and Sarawak ("Ecological Studies on the Rain Forest of Southern Nigeria". (1) "The Structure and Floristic Composition of the Primary Forest", *J. Ecology*, 27, 1; Feb. 1939. Univ. Press, Cambridge). The reasons for making such a comparison are not stated. The author states on more than one occasion that "the Rain Forest of the whole of South-Western Nigeria is situated near its climatic limits".

Discussing the remarkable uniformity of the forest attributed by Mildbraed to the great climatic changes the region has suffered in the past, causing great migrations of floras and levelling local peculiarities, the author says: "if this is so, it is easy to understand why regions on the extreme edge of the Rain Forest Area, such as South-Western Nigeria, should show a marked poverty in species". This insistence by the author is curious. Perhaps it is based on his statement that "it is generally admitted that the Cameroons is one of the richest regions of the African Rain Forest and is probably to be regarded as the chief centre of evolution of the Rain Forest flora". Yet the rain forest belt stretches to the west of Nigeria through the Gold Coast and through the French Ivory Coast, where it occupies extensive areas; which, in some parts, are claimed to be as fine examples and to produce as large a percentage of high-quality timber—mahoganies and so forth—as any other portion of the belt on the Coast.

The main differences in the author's comparison of the south-western Nigerian forest with that of British Guiana and Sarawak are: (1) that the first and second tree stories in Nigeria are more open, whilst the largest proportion of the third story is true third-story species; (2) the relative floristic poverty of the Nigerian forest; this poverty applying to all three stories of trees, to the shrub and herb layers, and to the climbers and epiphytes. In respect of single species dominance, the author considers the Nigerian rain forest as intermediate between British Guiana and Sarawak. Dr. Richards is of opinion that (1) and (2) above may be due to unfavourable climatic conditions, though with reference to (1) he quite correctly adds "though it is impossible to exclude human interference as a possible cause".

SEVENTY YEARS AGO

NATURE, vol. 2, June 23, 1870

The Unit of Length

"The battle of the Standards is over, and we may say the Metre has gained the victory. The need of a new system of weights and measures to amend the strange diversities which disfigure our practice being admitted, the question has once more been started—Should we once for all found our system on a natural basis ?" The seconds pendulum had been suggested but dismissed on account of the difficulty of ascertaining the real length of a normal pendulum. The advocates of the metre admit that greater accuracy is obtainable than that achieved by the French philosophers at the end of the eighteenth century, but point out that it is already a cosmopolitan unit, widely recognized, and in general use among many nations. Any slight error in its determination is more than counterbalanced by the extreme simplicity, symmetry and convenience of the metric system.

A Royal Commission which has considered the introduction of the metric system in Great Britain has recommended its legalization. "Since the complete substitution of the metric for the present practice is now practically certain, would it not be much better to prepare for the change and carry it into effect as speedily as possible ?"

Advertising

"WE have just seen a bill-head or order to which we think it necessary to call attention. On a scroll at the top is a name which, together with the address, which is on another scroll, we suppress. . . . In the centre is a coat of arms and crest surrounded by a garter, on which is printed *Fellow of the Chemical Society, London.* We have no wish to infer that this gentleman is not a most eminent chemist, but we do most emphatically protest against the membership of a learned society being turned to account for advertising purposes."

Museums of Natural History

"THERE is no doubt of the popularity of museums of natural history with the lower classes. That it is otherwise with more educated people is perhaps attributable to the fact that hardly any scientific knowledge is to be gained by a cursory inspection of crowded collections arranged with reference to economy of space rather than to the existing conditions of zoological science. It must not be forgotten that the sentiment of mere wonder . . . was satisfied, or at least blunted, in early childhood, in the case of those of us who have had access to well-illustrated books, and to the zoological gardens of great cities."

THE indifference of agriculturists to scientific research has been illustrated by the refusal of the Council of the Royal Agricultural Society to publish an account of the investigations which have established the truth of the old bucolic dogma, that berberries produce rust on wheat growing in their vicinity. There is now no doubt that the berberry-rust and the wheat-rust are two different stages in the genetic cycle of *Puccinia graminis*.

FORTHCOMING EVENTS

Monday, June 24

ROYAL GEOGRAPHICAL SOCIETY, at 3 p.m.—Annual General Meeting.

Tuesday, June 25

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5 p.m.—Annual General Meeting.

Prof. A. R. Radcliffe Brown : "On Social Structure" (Presidential Address).

AUSTRIAN ACADEMY IN GREAT BRITAIN, at 5 p.m.—Prof. Dr. Max Neuburger : "The Contribution of the Vienna Medical School to Medical Science".

Friday, June 28

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (in the Lecture Hall of the Science Museum, South Kensington), at 5 p.m.—Miss E. W. Parker : "The ASLIB Register of Technical House Journals".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

HEAD OF THE ENGINEERING DEPARTMENT of the Burnley Municipal College—The Director of Education, Education Offices, Burnley (June 26).

DIRECTOR OF EDUCATION for the Borough of Hyde—The Director of Education, Education Office, Union Street, Hyde (June 27).

LECTURER IN CHEMISTRY at the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne 2 (June 29).

EDUCATION OFFICER to the Community Service Council for Durham County, Ltd.—The Director, Hallgarth House, Durham (June 29).

ASSISTANT LECTURER IN PHYSICS—The Registrar, The University, Manchester 13 (June 30).

CHEMIST AND BACTERIOLOGIST to the Borough of Chelmsford Water Undertaking—The Town Clerk, Municipal Offices, Rainsford House, Chelmsford (endorsed 'Chemist and Bacteriologist') (July 1).

LECTURERS IN AGRICULTURE (two required)—Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (quoting "Lecturer in Agriculture") (July 8).

COMMISSIONED ORDNANCE MECHANICAL ENGINEERS in the Indian Army Ordnance Corps—The Secretary, Military Department, India Office, London, S.W.1 (quoting "Ordnance Recruitment") (July 8).

TWO TEACHERS (men) OF ENGINEERING SUBJECTS—The Principal, South Dorset Technical College, Newstead Road, Weymouth (July 27).

ASSISTANT LECTURER FOR MINING—The Principal, County Secondary School and Cumberland Technical College, Workington.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Nineteenth Annual General Meeting on May 28th, 1940. Pp. ii+46. (London : Empire Cotton Growing Corporation.) [305

Imperial Agricultural Bureaux. Joint Publication No. 3 : The Breeding of Herbage Plants in Scandinavia and Finland. Pp. 124. (Aberystwyth : Imperial Bureau of Pastures and Forage Crops ; Cambridge : Imperial Bureau of Plant Breeding and Genetics.) 4*s*. [305

Other Countries

Canada : Department of Mines and Resources : Mines and Geology Branch, Bureau of Mines. Comparative Tests of various Fuels when burned in a Domestic Hot-Water Boiler, 1925 to 1938. By C. E. Baltzer and E. S. Malloch. (No. 802.) Pp. v+23. (Ottawa : King's Printer.) 25 cents. [305

Newfoundland Government : Department of Natural Resources. Research Bulletin No. 7 : Investigations into the Life History of the Lobster (*Homarus americanus*) on the West Coast of Newfoundland, 1938. By Dr. W. Templeman. Pp. 52. (St. John's : Department of Natural Resources.) 20 cents. [305

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THE RANKS OF LIBERTY

THE ranks of liberty have suddenly been thinned ; physically they are weaker, but the blow has made them spiritually stronger. The action of the present French Government at Bordeaux has without doubt resulted in the capitulation of the mother country of the French Empire ; what line of action will be followed by her Empire over-seas remains to be seen.

No one can lay a finger on a specific reason for this catastrophe ; though the causes leading up to it have been manifold. It would be useless to close our eyes to the fact that one of the major causes has been—science. As the Prime Minister pointed out in the House of Commons on June 18, if we fail, the world will sink into the abyss of a new Dark Age, "made more sinister and perhaps more prolonged by the lights of a perverted science".

When the history of the present time, and especially of the period leading up to it, comes to be written, blame will be, rightly or wrongly, apportioned. Men of science have often heard their calling castigated for the use to which it is put in making mass murder, torture, bad faith and even treachery so easy as it is to-day. So, when the time comes, men of science will receive their portion, probably in excess, of the blame usually meted out by superficial thinkers. As we pointed out in NATURE of June 15, p. 910 : "the conscience of science is clear. She offers man a rope to skip : she cannot be blamed if he chooses to hang himself with it." Thus are we glad to note that the Prime Minister realizes that it is a "perverted" science which is being utilized to further Totalitarian aims. We claimed that "science is willing, nay eager, to assist [man] along the path of prosperity and happiness which she has helped to provide." Alas, many of those in authority are still unable or reluctant to grasp the great importance of what science and scientific workers offer to the advancement of civilization.

Much has been said and written about the social relations and implications of science. Men of science were becoming more and more aware of the humanistic aspect of their work, and great efforts were being made to bring the blessings of science to the forefront. But little has been done to prevent the perversion of science. An all too clear object lesson is now before us ; and when the question of reconstruction can be usefully considered, this aspect must receive its due measure of attention—and a very large one it must be.

Meanwhile there is much to be done at once. Our thoughts turn to our French colleagues in their present sufferings. At the moment their fate is not known. Many of them are undoubtedly remaining at their posts. What the future holds for them remains to be seen ; if they are treated as the men of science of other occupied territories are being treated, they will be able to carry on their work in a modified form, regimented as regards hours, etc.—not an ideal atmosphere for scientific work.

It is quite possible that some French scientific workers have reached Great Britain, and others may perchance follow. These are early days, and one cannot foretell how many or what type of scientific worker may succeed in obtaining sanctuary in Great Britain. But whoever comes must be given not only sanctuary, but also an opportunity to pursue his calling. Those whose work is of immediate importance to the war effort should be absorbed into the various Government research departments ; the others, surely, will not look in vain to our universities and other institutes of scientific research.

Over a period of several years, these centres of research have responded admirably to the call for aid from refugees from divers countries. Many such aliens have now been inevitably interned. Our French colleagues constitute a different category. Everything must be done to help them, though we fear that the terms imposed upon France will preclude most French men of science from leaving their country and continuing their work in that atmosphere of freedom which still prevails in Great Britain, and for which all British and all free French will continue to work and fight.

SCIENCE AND THE WAR EFFORT

SOON after the present Government took office, the Minister of Supply, Mr. Herbert Morrison, made a powerful appeal for intensification of effort in the production of munitions and other commodities, in the course of which he used a phrase, "Go to it", that has already become a slogan. He asked for speeding up of manufacturing processes, the over-riding of trade customs and the hard-won privileges of the trade unions, and in general the subordination of everyone and everything to the supreme task of winning the War. The military disaster in France has accentuated our need. From now on, Great Britain is the immediate target, and the need for munitions to replace losses in France, as well as to provide for the needs of the future, should require no emphasis.

The immediate demands of our war effort upon scientific workers and other technical experts are, of course, for the provision of the skilled work of control, in the testing of materials and products, and in the supervision of processes to ensure that the production of munitions of war, whether of explosives, guns, tanks, aeroplanes, war-chemicals or other products is smoothly, efficiently and safely maintained. This demands the continuous scrutiny of existing products and processes with the view of improving them and of replacing them by others superior to those used by the enemy.

All this, however, is only the first and possibly the least significant part of the contribution of science, great as are the demands it makes on the scientific worker for untiring accuracy, patience and skill. The nation's production of armaments must in some measure be related to the natural resources available. Unless the fullest possible use is made of these, we may be wasting our reserves of man power, of transport, or of foreign exchange.

It is difficult indeed to visualize the many ramifications here involved. The most effective utilization of coal, for example, affects not merely the manner of burning raw coal, its carbonization or conversion to coke or gas, or the generation of electric power. The by-product position has to be considered with reference to raw materials which it provides for explosives or other branches of chemical industry. Questions of atmospheric pollution and the like are also linked up with this question of efficient utilization of fuel, and it needs little imagination to visualize the reactions upon public health, problems of transport and the location of industry.

The importance of the scientific contribution is equally important in regard to questions of crop production. The decision as to which crops attention should be concentrated upon involves not merely an accurate knowledge of soil and climatic conditions, questions of shipping space, the interlocking of export policy and exchange reserves. It is linked up also with the whole policy of agriculture and food supply.

The importance of this latter question has been repeatedly stressed of late by Sir John Orr, Sir Daniel Hall, Mr. C. S. Orwin and others, who in the daily Press and elsewhere have stressed the necessity for a scientific policy of food production and directed attention anew to the valuable services rendered during the War of 1914–18 by the Food (War) Committee of the Royal Society. Their arguments have since been strongly endorsed in the Fourth Report of the Select Committee on National Expenditure, which expresses serious doubts as to whether sufficient use is being made of scientific research in regard to the wider issues in planning of food policy, such as the allocation of sugar or the planning on the basis of the fullest scientific study of a ration adequate in calories, etc., at a less cost in shipping and external currency than with the present normal form of diet. At present there is evidence that allocations of supplies are being made on the basis of a rough and ready compromise between various interests, and not on the basis of a plan scientifically devised in the interest of the country as a whole.

The problems of scientific discovery and progressive industry must be of paramount importance in our war effort. Ultimately such problems, of course, resolve themselves into the effective utilization of natural resources—the adaptation of industrial processes and methods to provide the products required by a war-time economy, whether to meet the demands of the Fighting Services, essential civil needs or the requirements of the export market, from the raw materials available under war-time conditions. Equally urgent is the question of developing or expanding processes for products which previously have been imported in whole or in part from countries which are now cut off. Such development or expansion may involve in the first instance intensive scientific research; for example, in the field of medicinals it may be necessary to elaborate processes for products which are urgently required to meet immediate war needs. Other scientific work may be required for the production of scientific apparatus on a much larger scale, or for the supply of products such as dyestuffs to seize the opportunities in export trade which have been opened to us by the blockade.

In the main, such problems are already being tackled by industry. There must, however, be continuous improvement both of our products and processes in the light of new knowledge, whether for offensive or defensive purposes, the service of essential civil needs or the export market, to establish an overwhelming superiority over those used by the enemy. This is a matter which involves the most effective utilization of our whole structure for fundamental as well as industrial research, and the bringing into the service of our needs that creative intelligence which is one of our greatest assets, as it is one of the great values in the heritage which we are defending. Here, above all, scientific workers must make their main contribution, not merely in the skill and resource with which they grapple with the immediate problems confronting them, but also in visualizing new problems and in organizing the most effective mobilization of all the resources of scientific knowledge or personnel to serve our myriad needs in this desperate struggle.

Nor is this merely a matter for the application of scientific knowledge and methods on the production side of industry alone. Science has almost equally important contributions to make in perfecting our methods of civil defence, in the mitigation of strain imposed by such conditions as the black-out or evacuation measures, and in safeguarding the health of the industrial workers and indeed of the whole civil population.

If we are to secure the maximum output from our mechanical equipment, very careful attention must be given to such questions as hours of work, canteens, rest periods, and the organization of holidays, so as to avoid interruption of output or throwing a strain on transport. The report already issued by the Industrial Health Research Board on industrial health in war has emphasized the dangers to efficiency as well as to health which may result from excessive hours or continuous work without intervals for rest, and from failure to give adequate attention to such matters as lighting, ventilation or accident prevention, as indicated in the experience gained in this field in the War of 1914–18. A letter from the Association of Scientific Workers on p. 1024 of this issue refers to this question, and recent utterances of the Minister of Labour and the appointment of a Factory and Welfare Advisory Board shows that the difficulties are appreciated.

Other problems, too, call urgently for scientific management. Such methods offer the best way of securing the more rational distribution of orders, increasing the mobility of labour and operating an efficient system of priority. Equally they play an important part in training the new workers required by industry for war purposes and in discovering, for example, just what kinds of skill can be acquired by intensive methods of only a few weeks duration. Technical education demands attention, for the training of highly skilled and responsible men in industry is a long-period problem, which must not be overlooked although the main and immediate problem of training is concerned with the hundreds of thousands of machine operators who are already needed.

If the tremendous drive in our industrial war effort to which we have been summoned by the Minister of Supply is to reach its full effect, it must be based on scientific knowledge and guided by scientific methods at all stages, in the planning of policy, in the development and in the control of processes and products. The contribution of scientific workers will demand the utmost vigour of creative thought and fundamental research, no less than the intense prosecution of the team-work characteristic of industrial research.

SALVAGE AND UTILIZATION OF WASTE

IT is of the very essence of war that every resource must be used to resist the advance of the aggressor. There is no room for half-measures; the War is the concern of every one of us; a steadfast purpose, high resolves and a capacity to put those resolves into action should dwell in the hearts and minds of all.

"What can I do to further the ends for which our country is struggling, to keep alight the lamps of freedom of thought and speech ?" is the question on the lips of millions of our fellows. "The work of the armed forces is clear before them; the farmer is providing essential food; the munition-workers' contribution is of primary importance. But what can I give to the cause, save by paying taxes, and by carrying on with my own work ?"

Much; and in many directions. An essential and vitally important help which every one of us may give, is summed up in the one word *economy.* Economy will indeed be forced upon us, for when the British national income at the outbreak of war was reckoned at £6,000 million per annum, the Government was taking from this income about £1,200 million. Thus £4,800 million were left in the pockets of the people. But if, owing to increased War-time effort, the national income should rise to £7,000 million, and the annual national expenditure to £4,000 million, then expenditure by the public *must* fall to £3,000 million. There is no gainsaying this. Economize we must, and it is well to begin early.

This, however, is but the passive side of war economy. Waste has a wide meaning, and while it is incumbent on each one of us to practise economy and to avoid waste, we must recognize the fact that there is an active side to the problem and another meaning to the term *waste.* Waste products of one trade are valuable raw materials for another; waste household products which in peace-time were rightly consigned to the flames, the rubbish heap, or the attic, become, in these days of war, essential parts of the national economy. Their usefulness must not be judged by ordinary economic standards; the national need is the determining factor. So important and pressing is this matter, that a special department of the Ministry of Supply—the Salvage Department—has been set up, which makes the gathering and utilization of such products its special concern.

The figures which deal with the amount of preventable waste are impressive. Thus, before the War, twenty thousand tons of paper and cardboard were thrown weekly into Great Britain's dustbins—well over a million tons a year. Such waste in war-time is almost criminal, and the Salvage Department is to be congratulated on the successful steps which it is taking to diminish this waste. During November last, the tonnage of waste paper collected was 4,500; during April of this year, 9,000.

There are few things considered less useful than woollen rags. Nevertheless, such rags are used in the manufacture of high-grade paper, and are the raw material of an industry that has flourished in the West Riding of Yorkshire for more than a century. This industry depended in the past on large supplies imported from abroad, and here, as in the paper industry, a substantial increase in the home supply will proportionately reduce the strain on shipping. They who produce, from the recesses of their wardrobes, old and long-discarded clothes, and see that they reach the appropriate distributing agency, will be doing a very real and important service. So also with ferrous (and non-ferrous) metals, all of which take on a new value as potential sources of high-grade steel.

The utilization of animal and vegetable refuse presents most curious and varied technical problems. Some of these problems have been efficiently solved; many others await solution. Most unexpected uses are to be found for various types of such refuse. Banana stalks, for example, of which many tons are available, are a most useful source of fertilizing material, and the household cooked bone has, from this point of view, scarcely any waste. One-eighth of its weight content is fat, one-eighth glue, and the remaining three quarters, properly treated, will appear as feeding meal for cattle, or as bone-fertilizer.

Here, then, is an example of work in which every one of us, townsman or countryman, child or adult, can take part. Such help as a single individual can give may seem a small matter, but in the aggregate the results obtained may be of far-reaching importance. The Salvage Department is doing its work well. In five months the number of town and other councils making returns has risen from 320 to 900, the populations which these councils represent being, in the first instance, 23 millions; in the second, 38 millions. This is a remarkable increase; but it must not be taken to imply that all the councils and local authorities in Great Britain are working at full pressure, or that they have completely developed their methods of attack on the task of the utilization of waste. Different councils have to face different aspects of the problem, and their solution calls for active co-operation between chemist, physicist, biologist and engineer. But the problem of bringing together the waste material is one to which everyone can lend a hand, and the schools can play a specially important part in this task.

Hitherto, the salvaging of waste material has been voluntary, in that local authorities have been asked to provide for the separate collection of material which can be utilized. The Minister of Supply has now announced that all local authorities with populations of more than 10,000 will be required to arrange efficient systems for the collection of salvage, and householders in these areas will be obliged to co-operate. Waste paper and cardboard, scrap metals and household bones are urgent needs, and other materials such as waste food and rags may be added to the list at a later date. The fact that a measure of compulsion is to be introduced need not deter the individual from continuing his own effort, on which, in the long run, will depend the outcome of the official drive for the collection of utilizable waste material.

A PIONEER IN PSYCHOLOGY

Psychological Issues
Selected Papers of Prof. Robert S. Woodworth. With a Bibliography of his Writings. Pp. x+421. (New York: Columbia University Press; London: Oxford University Press, 1939.) 22*s*. net.

WILLIAM JAMES once declared that psychology was not a science, but only the hope of a science. Much water has flowed under the bridges since that statement was made, and psychology may fairly be said to have proved its claim to recognition, notwithstanding that it is still split up into warring schools or sects. Few men have done so much to bring about the change as R. S. Woodworth, professor of psychology at Columbia University. As a student under James at Harvard, and later on as an assistant to Cattell at Columbia, he came under two powerful influences, which helped to shape his career, and partly explain the breadth of his interest in psychological problems, both on the physiological and on the statistical side. He has recently passed his seventieth birthday, and his colleagues in the department of psychology at Columbia, where he has taught for thirty-six years, have, without his knowledge or consent, prepared this commemorative volume. It was a gracious act, and one which will be warmly approved by many who only know Prof. Woodworth by his writings.

Most students of psychology know him by his "Psychology", a standard work now in its third edition, and by his "Contemporary Schools of Psychology" (1931), a book which bears the clear impress, not only of its author's ripe learning, but also of his wisdom and his sanity of judgment. Most of Prof. Woodworth's original work, however, consists of contributions to scientific journals spread over a period of more than forty years, with a list of titles covering a dozen octavo pages. This volume comprises some of his most distinctive work, ranging from an early note on the alleged rapidity of dreams (1897) to a paper for the *American Journal of Psychology* in 1937.

Not the least interesting part of the book is the chapter of autobiography written in 1932 for a comprehensive volume recording the careers of distinguished living psychologists. To an English reader there is one rather odd statement in this chapter. Prof. Woodworth relates that when he began studying psychology in September 1890, James's "Principles" had not yet appeared, and that there was probably no book in existence, at any rate in English, which could be recognized to-day as a text-book in psychology, the nearest approach being Carpenter's "Mental Physiology", a book dating from about 1870. This is surely rather hard on Prof. James Sully, a true man of science, whose "Outlines of Psychology", published in 1884, had completely superseded such books as Carpenter's and Bain's by the time that young Woodworth set out upon what proved to be a career of distinction. Perhaps it has made no difference in the end (who can tell?); but it must have made a difference at the beginning, that his advisers were not up to date.

CRYSTALLINE ENZYMES

Crystalline Enzymes
The Chemistry of Pepsin, Trypsin and Bacteriophage. (Columbia Biological Series, No. 12.) By John H. Northrop. Pp. xv + 176. (New York: Columbia University Press; London: Oxford University Press, 1939.) 15*s*. net.

THE chemical nature of enzymes has in the past been the subject of acute controversy. It has seemed impossible to many investigators to associate with molecules of high molecular weight their extraordinary power of controlling the complex reaction of living systems. Yet it is becoming more and more difficult to separate the study of enzyme activity from that of the proteins with which it is associated, and this is particularly true when we deal with crystalline enzymes. The characteristic activity of enzymes provides the most delicate test for their presence; they may be detected in solutions much too dilute to give positive protein reactions. But the enzyme crystals so far obtained are all protein crystals, and their preparation has proved an important step in relating the chemistry of enzymes to that of proteins as a whole. Since Sumner's first isolation of crystalline urease in 1926, some twelve different enzymes have been obtained in crystalline forms the variety of which reflects their diverse and specific chemical character. Of these, one of the most remarkable groups is that of the proteolytic enzymes studied by Northrop and his collaborators.

Northrop's present monograph is essentially an authoritative account of his own researches and does not deal, except in a general introductory way, with crystalline enzymes as such. It does include a general account of the problem of enzyme catalysis and reaction kinetics, but the sub-title of the book provides a more accurate description of its scope. For the principal beauty of Northrop's work lies not so much in the investigation of a large number of different enzymes as in the isolation of several closely related proteins and the study of their reactions one with another. We have here the beginnings of a chemistry of pepsin and trypsin in the same sense that we might speak of the chemistry of aniline—including the preparation of crystalline derivatives and the conversion of one protein into another and related and crystalline protein. But this chemistry of molecules of weight 30,000–40,000 is on a different scale of magnitude altogether from that we are accustomed to meet in classical organic chemistry.

Pepsin itself crystallizes in very characteristic hexagonal bipyramids which may, like many other protein crystals, contain a large proportion of impurities. The separation of different protein constituents during purification is best followed by solubility measurements, which distinguish pepsins derived from different sources, for example, swine and chicken pepsin, when other tests fail. So far it has proved impossible to relate the activity of pepsin to a particular prosthetic group, though it is evidently dependent on the presence of tyrosine in the molecule. One of the several reactions supporting this is acetylation, which leads under different conditions to the production of three different acetyl pepsins, all of them practically identical in crystalline form with pepsin itself. Only as the tyrosine groups are attacked in the second and third of these does the activity fall, first to 60 per cent, then to 10–15 per cent of its original value. A more profound modification of the molecule is involved in the formation of pepsin from its inactive precursor pepsinogen, which can be obtained crystalline in fine needles. Unlike pepsin, pepsinogen is stable in alkaline solution and is converted into pepsin by an autocatalytic reaction in acid solution. This reaction probably involves some splitting of the protein molecule; the two proteins are actually very similar in composition apart from the rather higher amino nitrogen content of pepsinogen.

A second important group of enzymes are the proteolytic enzymes of pancreatic juice, trypsin, chymotrypsin and carboxy peptidase. Trypsin and chymotrypsin both form particularly complicated series. Both have precursors, chymotrypsinogen (long needles) and trypsinogen (small triangular plates), which are converted into the active compounds under the influence of enterokinase, trypsin, and in the case of trypsinogen, a mould kinase. Chymotrypsin itself crystallizes in rhombohedra, but from its solutions separate two other enzymes, β-chymotrypsin (plates) and γ-chymotrypsin (short prisms). These are probably produced by slight hydrolysis of chymotrypsin itself, as they have lower molecular weights. Although similar in activity, they are distinct proteins with different solubilities which form solid solutions below *p*H 5·0 but crystallize independently between *p*H 5·0 and *p*H 6·0. The formation of trypsin from trypsinogen is complicated by the presence of a most interesting compound, trypsin inhibitor, which appears to be a polypeptide of molecular weight about 6,000. This crystallizes in long hexagonal prisms and with trypsin forms a 1 : 1 compound, also crystalline, inhibitor trypsin compound.

Among the most remarkable reactions described is that of reversible "denaturation", which is shown particularly by pepsinogen, chymotrypsin and trypsin. Solutions of these proteins may be heated to boiling and cooled again without loss of activity or potential activity. If the hot solutions are tested it is found that the protein present is inactive and can be precipitated by the addition of salt as if it were denatured. In the case of pepsinogen the protein is completely native below 50°, completely changed above 70°, and yet activity is restored on cooling. It would perhaps be better to use some special term instead of denaturation for this change, such as degeneration, as Astbury has suggested, since on long heating further changes take place which prove to be irreversible.

The study of the bacteriophage is still a stage outside the scope of the title of the book. It behaves in many ways as a nucleoprotein and its activity is destroyed by chymotrypsin, though not by pepsin or trypsin. Also heat-inactivated phage may be reactivated under certain conditions. But no phage has yet been crystallized, and Northrop concludes that it is impossible on the data obtained up to the present to decide whether phage should be classified with enzymes or with cells.

Northrop's monograph is throughout largely an account of work in progress and indeed of work which it is to be hoped will progress a great deal further. It is chiefly designed for the research worker in the field, who should find the detailed tables of preparations included in the appendixes invaluable. But the subject itself is of such interest and its presentation so clear that the book should have a very much wider appeal.

In conclusion, it would be worth buying if only for the very beautiful photographs of enzyme crystals that it contains.

Dorothy Crowfoot.

VIBRATION IN ENGINEERING PRACTICE

Mechanics Applied to Vibrations and Balancing

By D. Laugharne Thornton. Pp. xii+529. (London: Chapman and Hall, Ltd., 1939.) 36*s.* net.

Although there is no dearth of recent books on the subject of vibrations and the methods of balancing them, they all assume on the part of the reader a considerable knowledge of, and familiarity with, the dynamical principles on which the whole reasoning and mathematical treatment are built up. This, of course, is an essential preliminary but, owing to the different modes of presentation adopted by individual authors, there is for the average reader a somewhat difficult transition to be effected in switching from one form to another. For the designer, too, who has not been closely engaged in the more difficult problems of balancing, the first requisite is that these fundamentals should be clearly re-stated in direct association with the development of the main argument.

In this book, the author has dealt with each phase from the simplest beginnings, and has made a clear exposition of the basic principles the starting point of each argument. Although writing primarily for engineers and dealing with his subject in terms of units appropriate to the requirements of practical design, he has at the same time been sufficiently analytical to give his work a definite value to the student of physics, for whom an unusually wide range of examples is provided. On the mathematical side, a good working knowledge of the elements of calculus and of analytical geometry is a sufficient pre-requisite, as, where additional mathematical equipment is required, suitable explanation is given.

In the arrangement of the work two objects are clearly recognizable, the first being that of demonstrating the relation between the vibrations of unbalanced machinery and the vibratory motions thereby set up in foundations and supporting structures. These vibrations and their effects are particularly exemplified in chapters dealing with the influence of aero-engines on their fuselages and those of stationary, locomotive and marine engines on their surroundings. In dealing with the unbalanced dynamical forces and couples associated with these and other types of machines. Lagrange's equations are employed, and are enunciated and explained in some detail because of their utility in this connexion and also because of their value as an introduction to the idea of generalized co-ordinates as used in the more advanced theory of vibrations. Lagrange's method has the advantage in this type of analysis of enabling the main parts of an engine to be considered successively, so that it is possible to trace the relative motion between two parts due to the effect of a change of load and the elasticity of the connecting materials.

The second aim which can be noted is the presentation of problems pertaining to the design of buildings to withstand earthquakes, of which the author has had unique experience. This subject is discussed and illustrated by solutions to problems in which prescribed buildings are considered as a whole and as a structure composed of interconnected beams, columns and trusses. Here, too, the important question of foundations is dealt with, and in the same group may be mentioned the vibratory effects of traffic on roads.

The range of examples introduced is much too wide to be particularly classified, but it may be mentioned that they are representative of civil, mechanical, aeronautical, structural and marine engineering, and afford trustworthy guidance for most cases met with in practice.

ROCK-PAINTINGS IN SOUTH AFRICA

More Rock-Paintings in South Africa

From the Coastal Belt between Albany and Piquetberg. Mainly copied by Joyce and Mollie van der Riet. With Notes by the same and an Introduction and Explanatory Remarks by Dorothea F. Bleek. Pp. xx+28+28 plates. (London: Methuen and Co., Ltd., 1940.) 42*s.* net.

THIS volume, which has only thirteen pages of text, one map and twenty-eight plates with an explanatory page by Miss Bleek for each sheet of plates, describes a chosen number of rock paintings in the district of Grahamstown, half-way between Cape Town and Durban. They are some of the 145 examples copied by Miss van der Riet, Mrs. Ginn, Miss Sheila Fort and Miss Bright. There are also three plates of rather mediocre rock engravings, interesting because they show the extension southwards of this type of art. Some photographs of the originals are included.

On the whole, the art of the panels reproduced is not of a very high level, although the elephant shaded in reddish-brown (pl. 16–17) is very fine and so are the clothed and equipped archers (pl. 26), recalling some of the finest panels of Natal.

Among the most interesting subjects reproduced, all purely Bushman and previous to the arrival of other races, are the line of galloping springboks (pls. 15, 17, 19, 21*A*) in red, in the style I call 'spidery'; the battle between two tribes of Bushmen (pl. 5*A*) in red; the group of kneeling archers also in red drawing their bows (pl. 6*B*); the flying birds and circles of seated men painted in red (pl. 23); the little elephants grouped in a footprint of that animal (?) (pl. 27) also in red.

We must mention certain animals with their outline drawn in red and not filled in with colour, such as those in pl. 8*A* and *B*: one of these is an antelope, not an ox, with its horn (pl. 8*A*), seen full face, an example of twisted perspective rare in South African art.

There are very few big two-colour paintings of elands, and they are poor (pls. 1 and 28); the better two-colour paintings, which are rather good, are of antelopes (pl. 5*B*) and quagga (?) (pl. 10*B*). There are a few plants (?) (pls. 14*A* and 24); a rainbow (?) (pl. 7); an apron (?) (pl. 7); a skin water bottle (?) with its cords (pl. 19) near a man who seems to be climbing skywards with a rope; the spots near him suggest a rain-making rite.

A good many superpositions of the paintings are mentioned, only some of which are shown (pl. 5 *A* and *B*); brownish-red on faded red (pl. 23); three levels, yellow, red, then black (pl. 26); the black figures are obviously the latest in pls. 7, 9, 20, 25, 26; there are several paintings of baboons. A fine white and black ostrich reminds us of the celebrated ones published by Stow with the hunter disguised as an ostrich (pl. 2).

It is a pity this volume does not contain the whole block of paintings copied, even if only as small line drawings, for the chief interest in a regional investigation lies in an exhaustive study of the superpositions and styles which it exhibits. For example, stencilled feet and hands are mentioned, but there is no reproduction of them. It is said they are sometimes older and sometimes more recent than the figures; I can only say that at Riversdale, as at Wilton, where I saw them, they were far older than the figures. No late panels are given showing sheep, oxen, horses, etc.; such plates would have been valuable, making the book more complete. I have seen, for example, at Wilton, a big group of Hottentot white sheep with fat tails.

Still we thank Miss Bleek for having, so far as she could, enriched this publication, which completes her previous magnificent volume, and encourage her to pursue her fascinating study. She has pointed out in the text, with that authority which is her right, the differences in the artistic character of the various South African regions, differences which I need not enumerate.

H. BREUIL.

EARLY BOTANY AT OXFORD*

By Dr. J. Ramsbottom, O.B.E.,
British Museum (Natural History)

JOHN JACOB DILLENIUS was born at Darmstadt, Germany, in 1684. He studied at the University of Giessen, like several of his family before him. At an early age he became a member of the Academia Naturæ Curiosorum and contributed several papers to the *Miscellanea Curiosa* of that Society from the year 1715 onwards: among other matters these dealt with American species of plants which had become naturalized in Europe; Arabian coffee and his own *ersatz* preparations made by roasting peas, beans, kidney-beans and rye, the last being barely distinguishable from the real thing; the examination of mosses and other cryptogams with the view of ascertaining their sexual organs; and an experiment made with opium he had prepared from *Papaver somniferum* grown in Europe. He also wrote on leeches and butterflies.

In 1719 he published his "Catalogus plantarum sponte circa Gissam nascentium", a work which immediately established his reputation. It contains a list of plants gathered within a circuit of about a German mile and a half—approximately 980 species of flowering plants, 200 species of Musci and 160 species of Fungi; a large proportion of the Cryptogams had not previously been described. There is a critical examination of the systems of Ray, Knaut, Rivinus and Tournefort. Dillenius himself followed Ray's system throughout his career.

It was as a direct result of the catalogue that Dillenius was invited to Great Britain. William Sherard was at that time eminent in botany, so much so that Dawson Turner called him "the Sir Joseph Banks of his time". He had studied under Tournefort at Paris and later in 1704 was appointed Consul at Smyrna and there made a collection of plants and also did antiquarian exploration. At Tournefort's suggestion he undertook the continuation of Casper Bauhin's "Pinax", and on his return to England in 1716 he devoted himself to completing the work. The neglect of Cryptogams in Great Britain led him to enter into correspondence with Dillenius in 1718, and three years later, after sending for him, brought him over. Dillenius was engaged upon naming Sherard's collection of Smyrna plants and also on the "Pinax".

By that time the second edition of Ray's "Synopsis Methodica Stirpium Britannicarum", published in 1696, had become scarce, and Dillenius was employed in helping to prepare a new edition. This was published on July 17, 1724.

In 1726 Dillenius made a tour of the west of England and Wales in company with Samuel Brewer; Littleton Brown made part of the journey.

William Sherard died in August 1728 and left his books and plants and £3,000 for the maintenance of a professor of botany at Oxford. He nominated Dillenius to be the first professor for life.

Dillenius was fully satisfied with his work on the "Pinax", but James Sherard, after his brother's death, persuaded him to write an account of the plants cultivated in his garden at Eltham. "Hortus Elthamensis" appeared in 1732 in two folio volumes of 437 pages and 324 plates drawn and engraved by Dillenius. A large number of the then known species of Mesembryanthemum are figured and also some rare British plants. Sprengel described it as a most splendid work and Linnæus as "a botanical work such as the world had not seen". But Dillenius grudged the time he had spent on it. Further, he was shabbily treated by James Sherard, who complained that "he has not studied either to adorn his book or my garden; his chief care having been to improve and advance the Knowledge of Botany"—and Dillenius had to bear the cost of the production of a work James Sherard had designed "to make himself known". Many of the type specimens are preserved at Oxford. The drawings appear to have been lost.

There was difficulty over the Oxford appointment because of James Sherard's executors going to law, and Dillenius did not take up residence in Oxford until 1734, six years after William Sherard's bequest. In 1741 he published his "Historia Muscorum", a quarto volume of 576 pages and 85 plates—mosses including Bryophytes, Hepatics, Lycopods, Algæ and lichens. The original drawings of the figures on the first seventy-nine plates are in the Department of Botany; the remaining six plates were apparently drawn and etched directly on the copper. Dillenius died in April 1747 at the age of sixty-three—the great "Pinax" unfinished.

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*From the presidential address delivered before the Linnean Society of London on May 24, which dealt with a collection of drawings recently acquired by the Department of Botany, British Museum.

Such in outline is the life of one of the foremost systematists of his time—Linnæus says of the genus Dillenia, "of all plants the most distinguished for the beauty of its flower and fruit, like Dillenius among botanists".

Although Dillenius gained a considerable reputation from his Giessen Catalogue, this was chiefly because of the prominence he gave to Cryptogams. His Musci include not only the true mosses but also the lichens and some Algæ. For the first time mosses were split up into genera and names such as Mnion, Hypnum, Polytrichum, Bryum, and Sphagnum he took from Theophrastus, Dioscorides and Pliny.

Three years before the appearance of the Catalogue, Marsigli and Lancisi had published their letters on the nature of Fungi. Dillenius adopted their ideas, and his opinion is often quoted in the discussions which went on for a century or so. "A fungus," he says, "is a sterile kind of plant, that is to say destitute of flower and seed, arising from putrefactive fermentation, wherefore they arise chiefly during a moist and rainy period and consist for the most part of a soft and spongy substance yet retaining its characteristic look which it owes to a definite and specific juice of decay from which it originated ; and so, since by this putrefactive process the texture and elements of vegetables are considerably altered and almost destroyed, Fungi do not possess a green colour or have leaves, or even texture like other plants. Another consequence is that they usually spring up in a short space of time and are of equally short duration, or become the habitat and food of grubs and beetles, with the exception of not a few arboreal species that spring from the less liquid juices of wood and therefore last longer."

In spite of this belief which, logically, means that Fungi have no separate entity, Dillenius paid considerable attention to them and describes 162 species in his Catalogue. Drawings of 114 of these are in the present collection with 52 additional drawings. They are painted on separate pieces of paper and stuck on sheets on which the details are given. These drawings serve as the types of Dillenius's species and give his interpretations of previous descriptions.

Dillenius was recommended to Sherard "as a person very curious in mushrooms and mosses, as I perceive he is," and later Sherard writes : "I have brought over with me Dr. Dillenius who has with him most (if not all) of his *Fungi* painted". These drawings must be the ones mentioned. They are not of high artistic merit.

There is also a set of wash drawings of Fungi, all mounted on the same size of paper and arranged as if for publication. They seem to be copies, but they are from no work I know and, so far, I have not been able to match a single one of them except in Dillenius's own drawings. Can it be that they are the drawings mentioned by Sherard in a letter to Richardson dated December 26, 1723 ? "Dr. Dillenius has much improv'd in his painting. He has copied for me all Mr. Dandridge's *Fungi* and as many as he has been able to procure about London". Or are these, as Dr. Druce suggested, included in the drawings of Fungi at Oxford. These latter number 264 : the printed matter in Druce's "The Dillenian Herbaria" does not appear to support the suggestion for Dandridge's name is scarcely mentioned ; some of the Fungi are said to be from Giessen.

Another set of drawings, also in wash, is entitled "Plantæ novæ aut rariores ex Ephem. Nat. Curiosorum". It will be remembered that Dillenius himself was a member of the Academia Naturæ Curiosorum. These drawings on sixty-four sheets are copied from various plates which appeared in the Ephemerides together with full notes, and from Mentzel's "Pugillus" and Alpinus and Vesling's "De Plantis Aegypti". These, I imagine, date from his Giessen days, indeed probably when he was a student.

Although Dillenius's name is not on the third edition of Ray's "Synopsis" it would have been possible to guess that he was the editor even if it were not known for certain otherwise, for the classification adopted is practically that of the Giessen catalogue. It is common knowledge, however, that his name was omitted as "there was some apprehension (me being a foreigner) of making natives uneasy, if I should publicate it in my name". He had wished to dedicate it to Sherard and R. Richardson, "two persons that have contributed the most to its perfection", but the dedication being anonymous was "to all those Lovers of Botany, who contributed the most to the edition". There was even a suggestion that Isaac Rand's name should be given as editor, which apparently Sherard approved of, though he had himself done far more work on the "Synopsis", having on occasion worked ten hours a day on it. The "Synopsis" was illustrated with twenty-four plates. The only reference I have found to the fact that Dillenius did these is in a letter from Sherard to Richardson in which he says : "I know nothing further Dr. Dillenius has to do to the *Synopsis*, but the getting grav'd a few more plates, which may be done whilst 'tis printing". Richardson sent the money to pay for two plates, but Sherard returned it saying that it was a proper charge upon the publisher. The present collection contains the original drawings of all the plates except plate 1, though a few of the figures are missing ; the drawing for plate 23 is in pencil in an unfinished state. The original figures of plate 1, which illustrate Fungi, are amongst the Oxford drawings, according to Druce. Most of the drawings have the red chalk used in engraving still showing on the reverse side. But the interesting fact is that apparently it was intended that there should be sixty-eight plates. I have not traced any reason why all were not published.

The collection also includes a number of British plants. The specimens are in the Dillenian Herbarium at Oxford. There are further fifty sheets of drawings of plants probably from Giessen, and also sixty-three drawings of rushes, sedges and grasses.

The most numerous drawings are a set of about 320 labelled "Designationes and Icones plantarum in Horto Oxoniensi crescentium . . . 1744, 1746 dipictae." They are of great artistic merit and it need not be stressed that they are botanical drawings. In my opinion they place Dillenius among the front rank of botanical artists; it scarcely seems possible that they are by the same hand as some of the earlier drawings.

The Oxford Botanic Garden dates from 1621 and had only been planted with "divers simples for the advancement of the faculty of medicine" when the Civil War broke out. Jacob Bobart the elder was the first gardener appointed, though it seems that Lord Danby, founder of the garden, had previously negotiated with John Tradescant. The definite agreement between Lord Danby and Bobart was drawn up in 1641. Under Bobart's care the garden acquired a great reputation, and a catalogue of the plants there cultivated was published in 1648; 1,600 plants are included of which 600 were British. A second edition appeared ten years later with Philip Stephens and William Brown as co-editors with Bobart. Jacob Bobart the younger succeeded his father as keeper of the Physic Garden in 1679. There are two manuscript catalogues of plants growing in the garden and its neighbourhood in the Botanical Library at Oxford, and a number of manuscript lists of seeds and plants mostly sent or received by Bobart, in the Sloane Library.

After Bobart's retirement in 1718 there was no activity until the appointment of Dillenius. Sherard and others sent plants and seeds, but the neglect which had begun as Bobart grew old and feeble continued until 1734. Linnæus's famous visit to Oxford took place in 1736. It is probable that his main object was to see Sherard's herbarium, which in his judgement excelled all others in European plants, but the opportunity of meeting Dillenius was doubtless an additional attraction. There are several accounts of this visit. Dillenius, writing to Richardson, said that the visit lasted eight days, whereas Linnæus says that the learned Dillenius was at first haughty and distant, conceiving the "Genera Plantarum" to be written against him; but that he afterwards detained him for a month, without leaving him an hour to himself the whole day long, and at last took leave of him with tears in his eyes, after giving him the choice of living with him until his death, as the salary he thought was sufficient for them both.

By collating these various lists with the present drawings it should be possible to gain some idea of the plants in cultivation at Oxford when Dillenius was professor.

What was the purpose Dillenius had in mind in preparing these drawings? They were done with such care that it scarcely seems credible that they were drawn merely for amusement. We know that Dillenius regretted every moment away from the "Pinax" and yet here we have an enormous amount of time spent with what seems to be no purpose. Was it that Dillenius had in view the preparation of a volume dealing with the Oxford garden similar to "Hortus Elthamensis"? He certainly would have found it more congenial to work as he pleased than under the selfish criticism of James Sherard.

Dr. Druce overlooked the fact that Dillenius was a correspondent of John Bartram. His letters were usually sent through Peter Collinson, who also distributed seeds collected by Bartram. In 1737 Collinson sends names of his plants from Dillenius, and Dillenius received collections of seeds and plants until 1742. Bartram also collected mosses. "Before Dr. Dillenius gave me a hint of it, I took no particular notice of Mosses, but looked upon them as a cow looks at a pair of new barn doors."

We know that Dillenius was thoroughly dissatisfied at the loss he encountered by having to finance the publication of "Hortus Elthamensis". At James Sherard's desire he printed off 500 copies, but decided to have only 145 copies of the plates. Half a hundredweight of the paper—best Dutch paper—he sent to Bartram through Collinson, who wrote that it would "make noble books for specimens" and "think will furnish thee with paper for specimens, and for seeds, for thy lifetime". Drawings of some of the plants grown from Bartram's seeds are in the collection.

The last of the Dillenian material about which I wish to speak is the manuscript "Classis of Water Plants". It consists of thirty-two pages evidently written while in England and probably before he went to Oxford. He divides the plants into two groups: (1) such as bear neither (conspicuous) flowers, nor seeds, but propagate themselves by young leaves, growing out of the sides of their mother plants; (2) Apetalous seed-bearing water plants.

The account of each genus begins with the etymology of the Latin name followed by a generic description with references to figures and literature. For each species there is a description, place, use, synonomy, and critical remarks. The strange thing is that the account of Class I (six pages) is in English, that of Class II is in Latin. Obviously the work was intended for publication but, though it seems a fair copy, was never finished.

The full account of these additional Dillenian manuscripts will supplement that given by Druce and Vines in their "The Dillenian Herbaria". At the present time, it is interesting to note that the preface to that work dated 1907 ends: "At a time when two great and partly estranged nations are being brought closer together, may this work, insignificant in itself, yet as being compiled in the twentieth century by a British student to bear witness to the eminent service rendered to Botanical science in this country by a German botanist in the eighteenth, be an augury for their more kindly feeling and cordial co-operation in the progress of science".

OXIDATION OF METALS AND THE FORMATION OF PROTECTIVE FILMS*

By Prof. N. F. Mott, F.R.S.,

University of Bristol

A CHEMICAL process in which one of the reacting substances and also the product of the reaction are solid has one feature not shown when the product is gaseous or liquid; the product must necessarily form a barrier between the reacting substances, so that the reaction can only proceed either if the product is continually removed, or if the reacting substances can penetrate the barrier. In the oxidation of metals the rate of the reaction is almost entirely controlled by the rate at which metal or oxygen can penetrate the oxide layer. In general, as the oxide layer becomes thicker, the rate of reaction becomes slower. In some metals, notably aluminium, chromium and probably zinc below 225° C., oxidation stops altogether when the film has reached a thickness of the order of 10^{-6} cm., the protective film thus formed preventing further attack. The discussion of these protective films will be one of the chief purposes of this article.

Provided that one of the reacting substances can penetrate the oxide layer, we would expect that the primary process would be the formation of a fairly uniform film of oxide over the surface of the metal. In many cases, however, it seems certain that the oxide film breaks up as soon as it is formed, and recrystallizes in little islands scattered about the surface. The oxidation of zinc above 225° C. provides an example[1]. The oxide film shows a granular structure under the microscope, and does not show the interference colours obtained with compact oxide films on copper for example. Both facts point to the presence of a conglomerate of fairly large crystals of the type illustrated in Fig. 1(*b*) rather than a compact film. Electron diffraction experiments, moreover, reveal a well-defined crystalline structure.

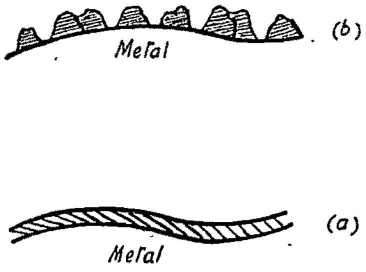

Fig. 1.

(*a*) A compact film and (*b*) a film that has undergone recrystallization.

The tendency of thin films on a substrate to recrystallize is well known, and is shown by the results obtained at Bristol by Appleyard[2], Lovell[3] and their co-workers on the conductivity of thin metal films evaporated on glass. Whereas it was found that by repeated degassing of the glass surface, and by depositing the metal at the temperature of liquid air, compact films of rubidium and cæsium could be obtained which would conduct electricity at a thickness corresponding to one or two atomic layers, other metals such as mercury, or alkali metals at higher temperatures, did not conduct until a thickness of about 500 A. was reached. It was concluded that the surface tension of the metal caused the splitting up of the film and its recrystallization in the form of crystals of about this size. Conductivity would begin when these islands were sufficiently numerous to be in contact with each other.

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* Substance of a lecture delivered before the London Branch of the Institute of Physics on April 30.

Vernon and his colleagues found that the weight W of oxide formed on zinc followed the law

$$W = k \log (at + 1), \quad . \quad . \quad (1)$$

or, expressed as a relation between the rate of growth and W,

$$\frac{dW}{dt} = ka.e^{-W/k} ;$$

a was of the order 0·5 (hr.)$^{-1}$. A law of this type gives a rapid initial rate of growth which later becomes vanishingly slow. For example, after 200 hours W will be $2k$, but will reach the value $4k$ only after 20,000 hours. Thus the thicker films must be quite impenetrable to metal or oxygen. The maximum thicknesses obtained are of the order 500 A., the same order as those at which the mercury films conduct. This thickness, however, and hence the size of the individual crystals, increases fairly rapidly as the temperature is raised, as we should expect.

The logarithmic law of growth can be derived on certain assumptions, of which the most important is that the rate of oxidation is proportional to the area of surface not already covered. For the proof the reader is referred to the original papers[4].

We turn now to the compact films formed on copper, iron, aluminium and so on. Two main types can be distinguished: those in which the parabolic law is obeyed, that is to say the weight, and hence the thickness of the film, increase as the square root of the time; so that

$$W = At^{1/2} ; \quad . \quad . \quad (2)$$

and those in which the film grows to a constant thickness d and then practically stops. The oxidation of copper at and above room temperature, of iron[5] above 200°C. and the reaction of silver with the halogens[6] are examples of the first class. The constant A, which determines the growth-rate, increases rapidly with temperature. The protective oxide films formed on such metals as aluminium, chromium and on stainless steels and zinc below 200° are examples of the second class. Here the thickness d which the film reaches seems to be relatively insensitive to temperature. (Experiments to establish this more definitely would be of great interest; the oxide film formed on aluminium at 600° C. in Pilling and Bedworth's work does not seem to be more than ten times heavier than that formed at room temperature. The former film had probably recrystallized.) An example of the second type of growth law is given in Fig. 2.

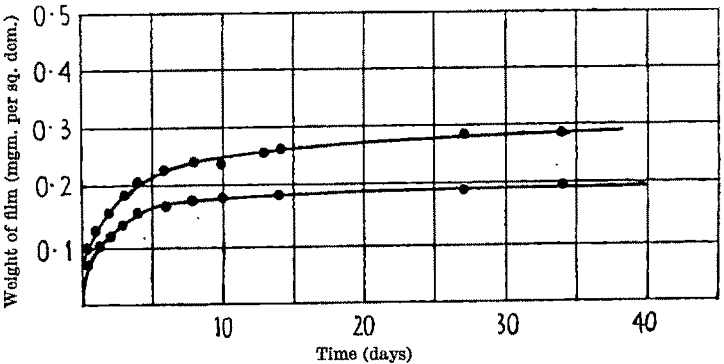

Fig. 2.

FORMATION OF ALUMINIUM OXIDE ON SHEET ALUMINIUM EXPOSED TO THE ATMOSPHERE AT ROOM TEMPERATURE (FROM W. H. J. VERNON, *Trans. Faraday Soc.*, 23, 113 (1927)).

The explanation of the parabolic law of growth was given some time ago by Tammann[7] and by Piling and Bedworth[8]. It is supposed that either the metal or the oxygen is soluble in the oxide. Let us suppose that the metal is soluble, the excess metal atoms going into interstitial positions in the oxide; then in the oxide in equilibrium with the metal there will be a certain concentration c_0 of excess metal atoms per unit volume. In the oxide film, however, while the reaction is in progress, there will be a concentration gradient of excess metal atoms, the concentration being c_0 at the oxide – metal interface, and zero at the free surface of the oxide, provided that the oxygen has pressure enough to react with the excess metal atoms as soon as they arrive. If x is the thickness of the film, the concentration gradient is thus c_0/x, so that the number N of excess metal atoms crossing unit area per unit time is given by

$$N = Dc_0/x,$$

where D is their coefficient of diffusion. But if Ω is the volume of oxide per metal atom, then the rate of growth dx/dt is equal to $N\Omega$; we thus have

$$\frac{dx}{dt} = \frac{D\Omega c_0}{x}, \quad . \quad . \quad (3)$$

which on integration gives

$$x^2 = 2\, D\Omega c_0 t ; \quad . \quad . \quad (4)$$

this is the required equation.

As equation (3) shows, the rate of growth for very small thicknesses becomes very great. We might expect then, in the initial stages of oxidation, especially at low pressures, that the oxygen pressure would not be sufficient to cause oxidation of the metal atoms as fast as they diffuse to the surface. In the initial stages of growth, then, we should expect a linear rate of growth. Wagner and Grünewald[9] have observed an effect of this type during the oxidation of copper at 1000° C. and a pressure of oxygen equal to that of 1 mm. of mercury. They found that until the film thickness had reached a value of the order 10^{-3} cm. the growth was linear, after which it followed the parabolic law.

We have next to consider whether, during the oxidation of any particular metal, the metal atoms move outwards through the oxide or the oxygen atoms or molecules move inwards. For the reaction of silver with (liquid) sulphur this has been settled experimentally in the following way[10]. Silver was separated from liquid sulphur by *two* slabs of silver sulphide, as shown in Fig. 3. After the reaction had been allowed to progress for some time, it was found that the upper slab II had increased in weight, but not the lower slab I. This shows that the silver diffuses through the sulphide and that the reaction takes place at the interface between the sulphur and the silver sulphide. If the sulphur were able to diffuse through the sulphide, the reaction would take place partly at the interface between the silver and its sulphide, and the weight of slab I would increase also.

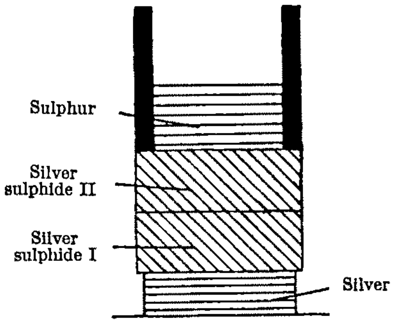

Fig. 3.

REACTION OF SILVER WITH SULPHUR.

In other cases conclusions may be drawn from the known properties of the oxides, especially from their electrical conductivities. The conductivities of oxides are in general due to the presence of small quantities of oxygen or of the metal constituent in excess of the stoichiometric composition, the excess atoms providing centres which lose an electron easily. The oxides of zinc and aluminium, for example, are what are known as reduction semi-conductors ; that is to say, their conductivity is increased by heating in a vacuum, when a small amount of oxygen is driven off and a corresponding number of metal atoms left behind, probably in interstitial positions. It does not seem possible, however, to produce these oxides with excess oxygen. We may reasonably assume, then, that the oxide film dissolves metal rather than oxygen, and thus that it is the metal ion which moves. An interesting consequence is that, for temperatures and oxygen pressures for which the parabolic law holds, the rate of reaction should be independent of the oxygen pressure for oxides of this type. This follows from equation (4) ; it will be seen that the reaction constant depends on the solubility of the metal only. However, as we shall see below, the parabolic law does not usually hold for this type of oxide.

Cuprous oxide, which is formed when copper is oxidized, is an oxidation semi-conductor ; that is to say, its conductivity increases when it is heated in oxygen, and is due to excess oxygen. There is evidence[11], however, that the oxygen is not taken up interstitially, the oxygen atom being too large to fit into interstitial positions in the oxide lattice. The way in which the lattice accommodates excess oxygen is through the absence from their normal lattice points of a few copper atoms. These vacant lattice points are mobile ; an adjacent metal atom can move into them, and then another atom will move into the position that has been left vacant, and so on. Thus in cuprous oxide also it is the metal atoms which move ; the vacant lattice points move inwards from the oxygen – oxide interface. In reactions of this type, the pressure of oxygen does have an effect on the rate of reaction, as has been shown for the case of copper by Wagner and Grünewald[9].

The oxides of iron form semi-conductors of the same type ; here the concentration of iron may have any value between those given by the formulae FeO and Fe_2O_3.

We do not know of any case of compact oxide films where it is established that the oxygen diffuses.

Wagner has suggested that the atoms diffusing through an oxide layer dissociate almost completely into ions and electrons. If the diffusion takes place through the motion of a vacant lattice point, then by dissociation we mean the following : If, for example, a Cu^{+} ion is missing, then a neighbouring Cu^{+} or O^{--} ion must have an electron missing, in order that the centre as a whole shall be electrically neutral. At high temperatures, however, the place where the electron is missing may move away from the vacant lattice point by a replacement process. It is suggested, then, that in cuprous oxide the vacant lattice points and the points from which an electron is missing (positive holes) are dissociated.

Estimates of the concentration of excess atoms and of the dissociation energy—the latter determined from the temperature variation of the conductivity of the oxide—enable a theoretical calculation to be made of the degree of dissociation, and the results bear out the hypothesis. More direct evidence has been obtained by Wagner[9] for the case of copper; he heated cuprous oxide at 1000° C. in oxygen until equilibrium was obtained, and measured the electrical conductivity; he found that it varied as $p^{1/7}$, where p was the pressure of oxygen. This is to be understood in the following way: each oxygen molecule gives two additional oxygen ions (O^{--}) in the Cu_2O lattice, and thus four vacant copper lattice points. If there were no dissociation we should expect the concentration to vary as $p^{1/4}$, if dissociation were complete as $p^{1/8}$, according to the law of mass action. The value obtained suggests that dissociation is nearly complete. As additional evidence, Wagner finds that the rate of oxidation of copper also varies as $p^{1/7}$.

We turn now to the consideration of the protective films formed on aluminium, chromium and other metals. The characteristic feature shown by these films is that they grow fairly rapidly up to a certain critical thickness, after which the growth is very small. The type of thickness-time curve is shown in Fig. 2. Various methods are available for determining the thickness of these very thin films. There is first of all the method of weighing before and during oxidation; this was used by Vernon to obtain the results shown in Fig. 2. To obtain the film thickness from the weight increase one must make an estimate of the true surface area of the surface area of an aluminium sheet. Erbacher[12] gives a ratio of 2·5 between the real and apparent surface, and using this factor we may deduce from Vernon's results a film thickness of 40 A. formed at room temperature. Steinheil[13] also obtained a thickness of 40 A. for the oxide film formed on aluminium after exposure to air for a few months by observing the progressive increase of transparency of evaporated aluminium films exposed to air. Tronstad[14] has used a polarimetric method to estimate the thickness, and gives the following table for films which have reached a constant thickness.

Mercury in dry air	15–20 A.
Aluminium in dry air	100–150 A.
Iron in dry air	15–40 A.
Austenitic stainless steel	10–30 A.

The crystal structure of the oxide films formed on aluminium has been examined by electron diffraction[15] using both reflected and transmitted beams; in the latter case the films were first stripped from the metal substrate. Very diffuse rings are obtained, suggesting that the films are built up of very small crystals. The films are thus to be contrasted with those formed by recrystallization, discussed at the beginning of this article, which give sharp rings. Another difference is that on aluminium, the maximum film thickness varies only slightly with temperature, whereas in the films formed by recrystallization the maximum film thickness increases very rapidly with temperature.

The present author has suggested a theory of the process responsible for the formation of these films[16]. This theory starts from Wagner's hypothesis that metal atoms diffuse through the oxide film in the form of metal ions and electrons separately. Since the films do not grow beyond a thickness of some 40 A. on aluminium, for example, it follows that either the ions or the electrons cannot pass through a thicker layer. It cannot, however, be the ions which find the difficulty, because oxide films thicker than 10,000 A. can be formed on aluminium by anodic oxidation[17], which shows that aluminium ions can pass through the layer if oxide *ions* are supplied at the surface.

It must, therefore, be the electrons which are unable to penetrate the thicker films. In oxide films which grow according to the parabolic law, one must suppose that electrons leave the metal and penetrate the oxide through a kind of thermionic emission; if an electron receives enough energy to leave the metal and move on to one of the metal ions of the oxide, it can jump from metal ion to metal ion and so on through the layer. We must suppose, however, that at the surface $Al-Al_2O_3$ the necessary work function φ is too great for this to happen up to 600° C., so that no emission will take place into a thick oxide film. This implies that $\varphi \geq 2$ ev. It is, however, possible for electrons to pass through a very thin film *without* receiving any energy of activation by what is known as the 'quantum mechanical tunnel effect'. According to the principles of quantum mechanics, it is possible for a particle to penetrate a small distance into regions of high potential energy for which, according to classical mechanics, its kinetic energy is insufficient. The principle has been used to explain, for example, the cold emission of electrons from metals in strong fields, and also the spontaneous α-decay of radioactive nuclei. The number of electrons per second penetrating a film of thickness x turns out to be about

$$10^{23} \quad e^{-4\pi x\sqrt{(2m\phi)}/h} \quad \text{cm.}^{-2}\ \text{sec.}^{-1},$$

giving a maximum rate of growth of the order

$$e^{-4\pi x\sqrt{(2m\phi)}/h} \quad \text{cm./sec.}$$

We may take the effective maximum film thickness to be reached when one atomic layer is added per year; for reasonable values of φ (1 to 2 ev.) this gives a thickness of 30–45 A.

We see, then, that when the oxide is a reduction semi-conductor, incapable of absorbing oxygen, the parabolic law of growth should be observed only if φ is not too large; if φ is large we get a protective film formed. On the other hand, if the oxide can absorb oxygen, the parabolic law will always be valid. Now it has been suggested on various sides[18] that reduction semi-conductors are oxides in which the metal ion has its maximum valency; and actually it appears that it is just oxide films of this type which are protective, namely, Al_2O_3, Cr_2O_3, ZnO. We have very little direct evidence[19] about the values that φ should have for metal - oxide interfaces, but it seems a not unreasonable assumption that φ is in general too large for thermionic emission. If this is the case we shall never get parabolic growth for this type of oxide, but always protective films less than 50 A. thick at low temperatures, and recrystallization leading to a logarithmic law of growth at high temperatures. For oxides such as Cu_2O, FeO, NiO on the other hand, the metal ion does not have its maximum valency, and the oxide can dissolve oxygen. Here we expect a parabolic law of growth producing a uniform film with interference colours. Recrystallization is not excluded for such films, but after it is complete the parabolic growth should continue.

The theory may also be applied to protective films on alloys. We have to note in the first place that protective oxide films can be formed at temperatures at which there is no possibility of metallic diffusion within the alloy. Therefore, when an oxide film is formed, both metals must enter into the oxide layer in the same proportion as that in which they are present in the alloy. That the constitution of the metal underneath the protective layer is the same as in the interior of the metal is also borne out by the fact that successive formations and removals of the protective films do not alter the capacity of the metal to form the films.

On the other hand, quite small additions of the second metal are sufficient to give considerable resistance to corrosion (for example, 7 per cent of aluminium in iron[20], or 3 per cent of aluminium in copper at 800° C.[21]). It is unlikely that 7 per cent of aluminium in ferrous oxide would be sufficient to alter the work function φ of the oxide - iron interface sufficiently to prohibit the passage of electrons. We therefore suggest that initially a mixed oxide is formed, but as the film thickens, the part of the film next to the metal becomes rich in aluminium (or chromium in chromium steels) until it becomes impervious to electrons, while an iron oxide film is formed outside it. The latter film is without influence on the protective properties.

The way in which this may be expected to happen is the following: so far we have considered the metallic ions as leaving the surface layer of the metal and moving in the oxide from one interstitial position to another until they reach the oxide - oxygen interface. Another process will probably occur at the same time; metal ions in an interstitial position will change places with metal ions in the oxide lattice. In an oxide of a single metal this process will not have any observable effect; but in the mixed oxide on steels the divalent ferrous ions will leave their lattice position with the expenditure of less energy than the trivalent aluminium or chromium ions. Therefore, in the layers next to the metal, the ferrous ions will frequently be replaced by the trivalent ions, while mainly ferrous ions will succeed in penetrating to the surface and forming new oxide layers.

It should be emphasized that our theory applies primarily to oxidation at low temperatures at which diffusion of one metal through the alloy is impossible. At high temperatures, on the other hand, it is possible that the proportions of the two metals in the oxide layer may be different from their proportions in the alloy. That this is the case is suggested by experiments of Iitaka and Miyake[22], who find that the protective films formed on copper - beryllium alloys containing one per cent of beryllium heated to a red heat give the electron diffraction rings characteristic of BeO alone. In order to explain these results, we may assume that diffusion within the metal takes place readily, and also that the beryllium ions diffuse through the oxide layer much faster than the larger copper ions, so that a protective film of BeO is formed before any appreciable amount of Cu_2O appears.

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OBITUARIES

Sir Jocelyn Thorpe, C.B.E., F.R.S.

SIR JOCELYN FIELD THORPE died suddenly on June 10 at the White House, Cooden Beach, Sussex. For many years he has been an outstanding and distinguished personality in chemical circles. Born in London on December 1, 1872, he was the sixth son of Mr. W. G. Thorpe of the Middle Temple. He was educated at Worthing College, at King's College, London, at the Royal College of Science, and took a Ph.D. degree in organic chemistry under Victor Meyer at Heidelberg. In 1895 he became research fellow at Owens College, Manchester, where he remained for about fifteen years. Inspired immediately by the magnetic influence of W. H. Perkin, jun., his future career was clear—research was to be the alpha and omega of his life. Alone and jointly he published many papers on subjects which were to serve as the foundation for many of the modern developments in organic chemistry. For four years, from 1909, he transferred to Sheffield, continuing to work on the same subjects as Sorby research fellow of the Royal Society.

The expansion of the Imperial College at South Kensington gave the opportunity to create a full professorship of organic chemistry in 1914. Thorpe held this post until his retirement in 1930, during which period he steadily advanced his reputation for research and teaching: he trained a large number of brilliant students and did much to place Britain in the leading position in organic chemistry which it occupies to-day.

Thorpe's earliest work deals principally with the synthesis of various degradation products derived from the terpenes as well as with cognate problems of aliphatic and alicyclic chemistry; this was published partly with W. H. Perkin, jun. Thorpe was particularly interested in the glutaric and glutaconic acids and their stereochemistry; the latter acids especially provided him with an extremely fruitful field of inquiry, which he exploited to the full after leaving Manchester.

Thorpe's frequent use of ethyl cyanoacetate for synthetic purposes led him to investigate the structure of this compound, and eventually led to the work on the reaction which bears his name. During the Sheffield period he published many papers on the glutaconic acids and produced evidence supporting his "semiaromatic" formula for this compound. This formula, though later abandoned, has points of resemblance with the modern concept of a resonance hybrid and bears testimony to his originality and independence of thought.

After the War of 1914–18, Thorpe's research school underwent a rapid expansion and attracted an enthusiastic band of workers to the Imperial College. Numerous papers dealing with ring formation and with tautomerism appeared in the next few years, although Thorpe's name did not always appear in these memoirs; he left much of the field to his younger collaborators (Ingold, Kon, Farmer, Linstead) and encouraged them to make a name for themselves.

Thorpe's wide knowledge of and abounding interest in chemistry was perhaps the reason why he accepted the task of producing first a Supplement to the "Dictionary of Applied Chemistry" which bears the name of the other Thorpe (Sir Edward) and later a new edition, which is in course of publication. In this he has been assisted by Dr. M. A. Whitely, one of his most loyal colleagues over a long period of years. Thorpe's conception of this dictionary was on the most grandiose scale, and the effort to produce it must be prodigious.

Externally, Thorpe might have been taken for a country squire: he acquired certain little mannerisms which made him resemble what one might describe in the words 'an Edwardian aristocrat'. Actually he was a simple person and though highly cultured and many-sided in his interests, in the main he lived for his research and for the advancement of co-operative chemistry. He was the born committee man and enjoyed serving on these, though he was seldom assertive. Among Government committees he served on the Advisory Council of Scientific and Industrial Research (1916–22); on the Chemical Defence Committee, War Office; as president of the Indian Chemical Services Committee (1919–20); as a member of the Safety in Mines Research Board (1924–25); and as chairman of the Explosives in Mines Committee, Department of Mines, and as a member of the Dye-stuffs Development Committee, Board of Trade (1925–34). He was a member of almost every chemical committee and served as president of both the Chemical Society and the Institute of Chemistry. The former conferred on him the Longstaff Medal in 1921, and the Royal Society gave him the Davy Medal in 1922. He was made C.B.E. in 1917 and knighted last year.

Thorpe made a great effort to unite various chemical interests, and in particular to found a common meeting place in a Chemistry House, but the task proved too difficult. He was undoubtedly happy in his work, and though it may be said that he spread his energies and efforts too widely to leave him time to achieve outstanding success in any one thing, it is probable that his contribution to the common cause, so wholeheartedly and unstintingly given, has over many years had a profound effect in awakening the co-operative spirit among chemists, who perhaps are even more individualistic than the average citizen.

His many friends knew his sterling merits; he understood and appreciated the luxuries in life, was a wonderful host, collected china, possessed a fine chemical library. He was greatly assisted in all he did by his wife, née Lilian Briggs, whom he married in 1902.

E. F. ARMSTRONG.

Sir Thomas Hudson Beare

THOMAS HUDSON BEARE was born at Adelaide, South Australia, on June 30, 1859, and was educated at Prince Alfred College and the University of Adelaide. After obtaining the B.A. degree he was awarded the Fife (Australia) scholarship, and he then proceeded to London, where he studied at University College and obtained the B.Sc. degree of the University of London.

Before leaving Australia, Hudson Beare held an appointment in the Public Works Department, and was engaged on railway construction, and after completion of the London degree he had further practical experience in the Midlands and in Manchester.

In 1884 he was invited to join the staff at University College, London, and for three years assisted Prof. A. B. W. Kennedy in teaching and in private professional work. In a testimonial written in his favour at the end of that period, Prof. Kennedy commented on his ability as a teacher and an organizer, on his knowledge and skill as an engineer. Shortly afterwards, Hudson Beare was appointed to the chair of mechanics and engineering in the Heriot-Watt College, Edinburgh. He was the first occupant of this chair, and in two years he built up a most successful department.

In 1889, on the resignation of Prof. Kennedy, he was appointed to the chair of engineering at University College, London, and was very largely responsible for the planning and equipment of the new Engineering Department which was built in 1895. During this period, in addition to his normal duties, he was able to carry out a considerable amount of research work, and was awarded the Telford Premium by the Institution of Civil Engineers for a valuable paper on "The Building Stones of Great Britain". As a member of the Research Committees on Steam Jackets and on Marine Engine Trials, he published several papers in the *Proceedings* of the Institution of Mechanical Engineers.

In 1901 Hudson Beare was appointed regius professor of engineering at the University of Edinburgh. The Engineering Department of that time was small, poorly equipped and very inadequately housed, but under Hudson Beare's energizing influence the number of students rapidly increased, and in 1905 the Department was accommodated in new and well-equipped premises. So successful was he that the Edinburgh school attracted students from all parts of the Empire, from the Continent, from China and South America, and it was again found that the accommodation was inadequate. Once more Sir Thomas undertook the design of new laboratories, and in 1931 the Department was transferred to the Sanderson Engineering Laboratories at King's Buildings.

In 1913 Sir Thomas was elected dean of the Faculty of Science at Edinburgh, a post which he held until his death on June 10 last, and his expert knowledge and great administrative ability enabled him to render invaluable service to the University. For many years he was convener of the Works Committee of the University Court, and carried the enormous responsibility of supervising the erection of many new departments and of the many alterations required to adapt the older buildings to modern requirements. In 1908 he was appointed convener of the Military Education Committee of the University, and his keen interest in military affairs was largely instrumental in raising the Edinburgh University contingent of the Officers Training Corps to its high state of efficiency. He also represented the University as a member of the City of Edinburgh Territorial and Air Force Association, and for a period acted as chairman.

Sir Thomas acted for several terms as vice-president of the Royal Society of Edinburgh, was vice-president of the Board of Governors of the Edinburgh and East of Scotland College of Agriculture from 1932, chairman of the Board of Governors of the Royal (Dick) Veterinary College from 1923, and for many years a governor of the Heriot-Watt College. In 1921 he was appointed by the Secretary of State for Scotland as an assessor on the Central Miners' Welfare Committee, and served on the Commission until the time of his death. His knighthood was conferred upon him in 1926, and ten years later he received the honorary degree of LL.D. from the University of Edinburgh. He was a member of the Institution of Civil Engineers, a member and later an honorary life member of the Institution of Mechanical Engineers, and a member and vice-president of the Institution of Structural Engineers. He was a justice of the peace and Deputy Lieutenant of the County of the City of Edinburgh.

A man of outstanding ability, Sir Thomas's interest lay not in himself but in the work which came to his hands. In the later period of his service his many administrative duties compelled him, of necessity, to give up research work but never prevented him from keeping closely in touch with the latest developments in engineering. Throughout all the years he was able to continue his clear and logical teaching in his own department. Keenly interested as he was in students and in all their activities, it is not surprising that he won their regard and confidence, and this was reflected in the close associations they maintained with him in after-life. He was not merely a teacher of engineering and a great figure in the profession to which they belonged, but also one who inspired them with a sense of conscientiousness, of honour and of integrity in the carrying out of the duties of life. During these almost incredibly busy years relaxation was found in travel and in the study of Nature, but even in recreation his alertness of mind asserted itself, and he was accepted by entomologists as an authoritative specialist on the systematics of the Coleoptera.

J. B. TODD.

Dr. Matthew Young

WE regret to record the death of Dr. Matthew Young, anatomist and anthropologist, which took place on May 25 at the age of fifty-six.

Matthew Young was born in Ayrshire and educated at Kilmarnock Academy and the University of

(*Continued on page* 1011)

NATURE

SUPPLEMENT

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SHORT REVIEWS

AGRICULTURE AND FORESTRY

A Text-Book of Agriculture

Designed for use in East African Schools. By J. G. Brash. Pp. xv+311. (London: The Sheldon Press, 1939.) 4*s*. 6*d*.

THE writing of a text-book of agriculture in English for use by a body of students whose knowledge of English is very meagre is surely a most difficult task. This is evidently realized by the author of the present book, for he includes a glossary not only of technical terms but also of words and expressions commonly in use in ordinary English. But if the task of preparing such a text-book must be faced, we have seen no attempt which attains a greater measure of success than that now under consideration. Apart from the language difficulty in the present case, there is another, which is referred to in the author's foreword, namely, that the pupils for whom it is designed look upon the study of agriculture in the schools as a disagreeable necessity, for most of them join the higher schools chiefly for the purpose of gaining a higher social status by getting remunerative employment on the completion of their school courses, and hence are in most cases only interested in those subjects which are required for such paid positions as are available to them.

Yet, in a country of which the whole economic future depends on agricultural progress, the latter must chiefly come through the younger generation who are now in the schools. It would seem, therefore, that if these young people are really to be weaned from the desire for mere clerical positions to a genuine devotion to the improvement of agriculture, there must be text-books which are of exceptional interest, and also inspiring teachers of the subject in the schools. Without the latter, the text-book will do little: with them, it would not be easy to prepare a better book than that under review.

In it, the principles of agriculture as applied to East African conditions are admirably presented, with emphasis on those matters which have proved to be the most important for the development of the country. Special features are the very lucid account of erosion and the methods of combating it, and a useful chapter on the co-operative organization of agriculture as it can be developed in East Africa.

The book can be highly recommended. It does almost all that a text-book can do in connexion with agricultural teaching in East Africa, but neither it nor any other text-book can direct interest and attention back to agriculture in the absence of an inspiring teacher. If the latter is there, then the book will be found of great value. H. H. M.

Timber

Its Properties, Pests and Preservation. By Dr. F. Y. Henderson. Pp. 186+19 plates. (London: Crosby Lockwood and Son, Ltd., 1939.) 9*s*. 6*d*. net.

NUMEROUS technical publications have been issued which deal separately with different aspects of timber technology, but none has appeared in Great Britain in which a general elementary account of timber in non-technical language is given. The book under notice, written primarily for students of engineering and building science, fills this gap. The text covers briefly the whole general field of timber technology as indicated under its sub-titles, and is profusely illustrated with line drawings and photographs, the majority of which are original. The style is refreshingly simple and straightforward, thus bearing the hall-mark of an author who not only knows his subject, but also has the gift of being able to put himself into the position of the student and general reader who is taking up the subject for the first time.

This book should prove of great value not only to engineering and building students, but also to the general public, all of whom are users of timber. In war-time it is important that the most economical use be made of our timber resources, and it is only through knowledge of its properties that it can be used most profitably. It is unfortunate that the price may put this book out of reach of many, but this is doubtless due to the general rise in cost of production, but to those who can afford it the nine shillings and sixpence should prove an excellent investment. K. ST. G. C.

Soil Analysis

A Handbook of Physical and Chemical Methods. By C. Harold Wright. Second edition. Pp. x+276. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co. Inc., 1939.) 12*s*. 6*d*. net.

THE first edition of this book, although written particularly for those who have not the facilities of a good library, proved a useful addition to the bookshelves of most agricultural chemists. In this revised edition the author has replaced methods of analysis that were becoming out of date or of only minor importance by new ones. Some fresh sections have been added dealing with the freezing point, glass electrode, inorganic soil colloids and methods for the determination of cobalt and zinc. To the section on carbon the Ter Meulen dry combustion method has been added, together with a summary of the report of the Organic Carbon Committee of the International Society of Soil Science. This Committee compared a number of methods for determining carbon in soils, and the results and experiences of the analysts should be useful to soil chemists.

In presenting the chemical methods of analysis in his book the author has divided them into general and special methods, but the reviewer suggests that this grouping is not entirely satisfactory, since the ordinary Kjeldahl method for nitrogen and common methods for carbon are to be found under special methods, whereas the determinations of phosphoric acid and potassium appear in the general class. This is only a very minor criticism, and in no way detracts from the value of the book.

R. G. WARREN.

ANTHROPOLOGY AND ARCHÆOLOGY

James George Frazer

The Portrait of a Scholar. By R. Angus Downie. Pp. ix+141. (London: Watts and Co., Ltd., 1940.) 5*s*. net.

THIS "portrait of a scholar" is drawn by one who now for a number of years has been associated with Sir James Frazer's work. That association has been fruitful in producing the supplementary volumes of "The Golden Bough" and "Totemism", as well as the five volumes of selected extracts from the notebooks which bear testimony to the life-long and unremitting industry which Sir James has devoted to the commendable practice of note-making. A further outcome of this association is that it has given Mr. Downie an acquaintance, intimate and unrivalled, with the lines of every branch of investigation upon which Sir James has brought his genius to bear, as well as a clear insight into the working of his mind, so far as that is possible when dealing with a subject who both as an individual and as author exhibits in a supreme degree the scholar's qualities of balance and restraint.

Sir James Frazer's life-history is the story of his work; and he lives in his books. For the benefit of those who may know but little of that work, who perhaps have come into touch with only one aspect of it, or indeed may not know it at all, Mr. Downie has sketched a portrait of a many-faceted mind, and of what, had Sir James been a man of action, would have been termed justly a life of adventure in many fields. For in the realms of the mind Sir James has been a traveller in many remote tracts and untrodden ways, a pioneer and explorer in the dark ways of humanity. Chapter by chapter, Mr. Downie guides the reader, assisting his steps with illuminating quotation, from Sir James's early work at Cambridge and his association with Robertson Smith to "The Golden Bough", to "Totemism" and to "The Folklore of the Old Testament", to name the more important only among his monumental contribution to the comparative study of the human mind, its beliefs and the institutions to which it gives rise. But these, though the best known, do not complete the tale of his activities. In addition, there are the classical studies by which he first earned his right of entry to the learned world and produced his "Pausanias" and the "Fasti" of Ovid, border-line works; and there are also those purely literary studies of Cowper and Addison and the other 'pieces' in which some hold Sir James has risen to the highest point of that stylistic excellence which Mr. Downie rightly stresses throughout.

The Illusion of National Character

By Hamilton Fyfe. Pp. v+274. (London: Watts and Co., 1940.) 8*s*. 6*d*. net.

MR. HAMILTON FYFE sets out to destroy the generalizations about peoples—mainly the illusion of national character—which in past and current discussion obscure counsel. While some generalizations about large groups are possible, is it true that general statements about Englishmen, Frenchmen or Germans are valid, apart from affirmation of such externals as membership of a particular State, geographical habitat or language? Is there over and above these such a thing as national character? As will be gathered from his title, in the judgment of the author there is not. Even though he is prepared to concede certain differences due to surroundings, he would maintain that, beneath, these peoples are alike. On this it may be remarked that while this may be true of race in a biological sense and the so-called 'racial theory' a delusion, when it is not a fraud, national character stands in a different category. The cumulative effect of cultural continuity, viewed historically, cannot be ignored; any attempt to do so will be no less disastrous than the exaggerated nationalism which has brought about the War.

BIOLOGY

Graptolithina

Von O. M. B. Bulman. (Handbuch der Paläozoologie, herausgegeben von O. H. Schindewolf, Lieferung 2, Band 2D.) Pp. iii+92. (Berlin: Gebrüder Borntraeger, 1938.) 13 gold marks.

THIS is the first part to be published of a comprehensive treatise on palæozoology. The general plan is similar to that of Zittel's great "Handbuch" (1876–93), but whereas that work was in four volumes and, with the exception of the parts on Insecta and Myriapoda, was written entirely by von Zittel, this new work is to consist of twenty volumes by nearly fifty specialists.

In this part, Dr. Bulman gives a masterly account of the Graptolithina. Each of the two main divisions, the Dendroidea and the Graptoloidea, is considered under the headings: diagnosis, morphology, development, ecology, distribution, phylogeny and systematics. There is no separate section on the history of the subject, but the development of knowledge is indicated in each section of the work. The illustrations are numerous, and those showing morphology and development are especially noteworthy. In the systematic part diagnoses are given of all the known genera. It is to be regretted that the outstanding work of Kozlowski could only be considered briefly in a postscript. His discovery in the Upper Tremadoc, south of Warsaw, of the most perfectly preserved Dendroids yet known has led him to the conclusion that the Graptolites are not hydroids, but are closely related to the Pterobranchia among the Hemichordata. This is supported by the presence among the Graptolites of a Pterobranch allied to the living Cephalodiscus.

Elementary Microtechnique

By H. Alan Peacock. Second edition. Pp. viii + 330. (London: Edward Arnold and Co., 1940.) 9*s*.

REASONABLY priced, compact, well bound and clearly written, this book surpasses the high standard already set by the author in the first edition. There are chapters on the microscope and its use, methods of making preparations of animal and plant tissues, methods of wax-embedding, formulæ, sources and culture of material, preservation of material, etc.; while more than a hundred pages are devoted to methods of dealing with specific material, both plant and animal. There are also an excellent little bibliography and a list of dealers from whom amateurs or schools not favourably situated can obtain enough to satisfy the most exacting student of the microscope. The author has done well to set out his practical instructions line by line in numbered sequence, adding the length of time for applying each reagent and giving a number of alternative methods. For the next edition, the author should consider omitting the chapter on the protoplasm and the cell (too short to be of great use) and substitute a few pages on the cultivation of microscopic fungi, with details of various nutrient media in common use. All students and teachers of biology owe thanks to Mr. Peacock for this excellent little compendium; for its scope there is none better.

Food Values at a Glance

And How to Plan a Healthy Diet. By Violet G. Plimmer. Second edition. Pp. 190. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1939.) 6*s*. net.

MODESTLY disclaiming any expert knowledge of nutrition, Mrs. Plimmer has launched the second edition of this useful little work at a time when, as she herself puts it, there is opportunity to recast and modernize our defences on the food front. Her disclaimer is misleading if by the knowledge of nutrition we understand a knowledge of how properly to nourish the body, because here are all the essential facts clearly presented and in very readable form. Although I do not think every reader will find Mrs. Plimmer's "Neapolitan Ice" method of portraying the composition of foods as convenient to refer to as the more customary tables, it at least lends colour to the commonsense account she gives of up-to-date views on diet in relation to health and fitness. At a time such as the present this handy little work should be widely read. J. C. D.

The World of Insects

By Prof. Carl D. Duncan and Prof. Gayle Pickwell. Pp. ix + 409. (New York and London: McGraw-Hill Book Co. Inc., 1939.) 21*s*.

THIS book is one of the best elementary manuals on insect life that has appeared during recent years in the United States. It is well adapted for the general reader or the student-beginner, since technicalities are reduced to a minimum and the subject is attractively presented without a noticeable tendency to be unduly popular. While sufficient grounding in structure and classification is given, the book, in the main, is concerned with living animals, and more attention is shown to such matters as life, growth, behaviour, food, locomotion, etc. There is also a useful chapter on injurious insects and the means for their control. The illustrations are very good and original, and comprise both line and half-tone examples. Many of the latter are really effective results of the expert use of photography.

Calluna

A Monograph on the Scotch Heather. By W. Beijerinck. (Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen, Afdeeling Natuurkunde, Sectie 2, Deel 38, No. 4.) Pp. 180 + 30 plates. (Amsterdam: N. V. Noord-Hollandsche Uitgevers Maatschappij, 1940.) 7.50 fl.

IN view of the great importance of Calluna in diverse types of vegetation, a monograph, which aims at bringing together all that is known about this plant, will be very welcome to the ecologist. The author has sifted a large volume of literature and, where needful, has supplemented available information by his own investigations so that information on a wide diversity of topics is provided. Considerable space is devoted to a consideration of external and internal structure, as well as of the life-history, and this is copiously illustrated. Occasional points are obscure; for example, it is difficult to follow the data on cork-development on p. 34. On the ecological side the monograph falls a little short of the ideal. Thus, there is but little information on such topics as rooting depth, seedling mortality, and regeneration after fire, while the British reader would no doubt seek more data than are afforded on the vegetation-types in which Calluna plays a part. The subject-matter is well arranged, but for a treatise of this size some kind of index would have been desirable. F. E. F.

ENGINEERING

The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1940

A Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford-Smith. 46th annual issue, revised under the direction of L. St. L. Pendred. Pp. lxi+xii+2788. (London: Morgan Brothers (Publishers), Ltd., 1940.) 31*s.* 6*d.* net.

SUBSTANTIALLY the same publication in the form in which it has appeared for a number of years, "Kempe's Engineer's Year-Book" has been issued in its 1940 edition. Though once again in its forty-six years' history it has been published in time of war, this fact has not changed its form or restricted the great range of the information it presents. A few changes there have been, but these are in the nature of those developments which must necessarily take place in a work of this kind in order to keep it up to date and to maintain its usefulness at a maximum. The section dealing with the costs of engineering works has therefore been excised, for at the time of preparation it was apparent that the prospects of war negatived its value for so long as conditions should remain abnormal. The space thus released has been occupied with some of the mathematical tables which were discarded a few years ago so that the bulk of the volume might be limited.

The original aim of its first editor to produce a work which, being carefully brought up to date, shall take its place as the standard book of reference in the profession is fully maintained in the latest issue. The list of associate editors and contributors, forty-six in number and each responsible for the preparation of a section, contains the names of recognized experts, most of them engineers, and the section dealing with timbers has been revised by the Forest Products Research Laboratory. The user can therefore feel fully confident that the information given throughout its pages is in the highest degree reliable. In a way, it appears at a psychological moment, for with the whole engineering profession of Great Britain organizing itself for its duties in the War, and its members engaged in new work, the need for such a work of reference is greatly enhanced.

The Engineers' Manual

By Prof. Ralph G. Hudson. Second edition. Pp. iv+340. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 13*s.* 6*d.* net.

PROF. HUDSON'S book contains what may be regarded as the 'permanent information' of engineering. It comprises a consolidation of the principal formulæ and tables of mathematics, mechanics, hydraulics, heat and electricity in frequent use by practising engineers and engineering students. As each set of formulæ is preceded by a statement giving its application, the physical quantities involved and the units of measurement used, the appropriate formula is quickly selected and accurate substitution readily effected. The sequence in which the formulæ are arranged is, so far as possible, that of the order of derivation, so that, where it may be required, the source of any statement can be recognized from an inspection of those immediately preceding it.

GEOGRAPHY AND TRAVEL

The Scenery of Sidmouth

Its Natural Beauty and Historic Interest. By Dr. Vaughan Cornish. Pp. xiii+86+6 plates. (Cambridge: At the University Press, 1940.) 7*s.* 6*d.* net.

NO one has raised his voice more frequently or with greater sincerity for the preservation of the beauties of rural England than Dr. Vaughan Cornish. To him, as indeed to many others, the charm of our English countryside is one of the priceless heritages of the land, and he says with truth that sorrow is softened and hope strengthened by the peaceful beauty of rural England. In earlier works Dr. Cornish has tried to establish general principles for the æsthetics of scenery. In this small book he illustrates these principles by the analytical description of a small area. The corner of South Devon he has chosen is one of long family associations; and he has been able to give practical expression in it to his desire for preserving beauty in saving the valley of Salcombe Regis from spoliation by the builder. It is a charming volume, which shows the mingling of scientific spirit and æsthetic appreciation in the manner that the author has made all his own, and it provides at very least an hour or two of soothing comfort in these dire days. There are charming illustrations and an excellent map.

The Statesman's Year-Book

Statistical and Historical Annual of the States of the World for the Year 1940. Edited by Dr. M. Epstein. Seventy-seventh annual publication: revised after Official Returns. Pp. xxxviii+1488. (London: Macmillan and Co., Ltd., 1940.) 20*s.* net.

EVEN in these difficult times this annual statistical review of the world appears, not merely with regularity, but also with all its usual features and at the usual price. The task of revision has presented many obstacles, and for several States the discontinuance of official statistics has been a drawback. Yet the picture of the world in the opening quarter of this year is wonderfully complete. States now in enemy occupation appear in their rightful places: thus Poland, and Danzig, as well as the later occupied western States, retain their nominal independence. Czechoslovakia and Albania also have their places, but Ethiopia is submerged. Even the League of Nations still figures, but the list of non-members is now a long one. The useful introductory tables give world production of petroleum, cotton, iron and steel, gold and rubber. A coloured folding map shows the extent of the U.S.S.R. with indications of the various degrees of autonomy, 'protection' and influence attributed to the different constituent States and territories.

RECENT SCIENTIFIC AND TECHNICAL BOOKS

Volumes marked with an asterisk (*) have been received at "NATURE" *Office*

Mathematics : Mechanics : Physics

Bennett, C. M. Easy Mathematics. Book 1. Ex. Cr 8vo. Pp. vi +138. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 1*s.* 9*d.*; with Answers 2*s.* 3*d.*

Borel, Émile, et Chéron, André. Théorie mathématique du Bridge à la portée de tous. (Monographies des probabilités, Fascicule 5.) Roy. 8vo. Pp. xviii +392. (Paris: Gauthier-Villars, 1940.) 175 francs.*

Dugas, R. Essai sur l'incompréhension mathématique. 8vo. Pp. 132. (Paris: Libr. Vuibert, 1940.) 25 francs.

Fielding, T. J. Photo-Electric and Selenium Cells. Second edition. Ex. Cr. 8vo. Pp. vii +163. (London: Chapman and Hall, Ltd., 1940.) 7*s.* 6*d.* net.

Harrison, George Russell. Atoms in Action: the World of Creative Physics. Demy 8vo. Pp. x +370 +16 plates. (London: George Allen and Unwin, Ltd., 1940.) 12*s.* 6*d.* net.*

Hymans, J. C. S. Simple Mathematics for Gunner Officers. Cr. 8vo. Pp. xi +39. (London: Gale and Polden, Ltd., 1940.) 1*s.* 6*d.*

Kármán, Theodore v., and Biot, Maurice A. Mathematical Methods in Engineering: an Introduction to the Mathematical Treatment of Engineering Problems. Med. 8vo. Pp. xii +505. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s.**

Lindsay, Robert Bruce. General Physics: for Students of Science. Med. 8vo. Pp. xiv +534. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 22*s.* 6*d.* net.*

Littlewood, Dudley E. The Theory of Group Characters and Matrix Representations of Groups. Roy. 8vo. Pp. viii +292. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 20*s.* net.*

Lloyd, Ll. S. The Musical Ear. Demy 8vo. Pp. ix + 88 +2 plates. (London, New York and Toronto: Oxford University Press, 1940.) 6*s.* 6*d.* net.*

Lyness, R. C., and Milford, Michael. Simple Algebra. Cr. 8vo. Pp. 199. (London: Edward Arnold and Co., 1940.) 3*s.*; with Answers, 3*s.* 6*d.*

Manfield, G. W. Essential Arithmetic. Cr. 8vo. Book 1. Pp. 80. 1*s.* 3*d.* Book 2. Pp. 80. 1*s.* 3*d.* (London: Edward Arnold and Co., 1940.)

Mott, N. F., and Gurney, R. W. Electronic Processes in Ionic Crystals. (International Series of Monographs on Physics.) Roy. 8vo. Pp. xii +276. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 20*s.* net.*

Spectroscopy. Proceedings of the Seventh Summer Conference on Spectroscopy and its Applications, held at the Massachusetts Institute of Technology, Cambridge, Massachusetts, July 17–19, 1939. (A publication of the Technology Press, Massachusetts Institute of Technology.) Cr. 4to. Pp. viii +154. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 16*s.* 6*d.* net.*

Strong, John; in collaboration with **Neher, H. Victor; Whitford, Albert E.; Cartwright, C. Hawley, and Hayward, Roger.** Modern Physical Laboratory Practice. Med. 8vo. Pp. x +642. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 35*s.* net.*

Engineering

Agg, Thomas Radford. The Construction of Roads and Pavements. Fifth edition. Med. 8vo. Pp. xiv +483. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s.*

Albert, Arthur Lemuel. Electrical Communication. Second edition. Med. 8vo. Pp. ix +534. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 30*s.* net.*

Atherton, William H. Hoisting Machinery. Med. 8vo. Pp. xii +314. (London: The Technical Press, Ltd., 1940.) 32*s.* 6*d.* net.

Beckett, C. S. Generation and Transmission. Med. 8vo. Pp. 118. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s.* net.

Canfield, Donald T. The Measurement of Alternating Current Energy. Demy 8vo. Pp. xi +210. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 12*s.*

Department of Scientific and Industrial Research. Sound Transmission in Buildings: Practical Notes for Architects and Builders. By R. Fitzmaurice and William Allen. Roy. 4to. Pp. viii +50. (London: H.M. Stationery Office, 1939.) 4*s.* net.*

Department of Scientific and Industrial Research: Building Research. Wartime Building Bulletin No. 1: Economical Type Designs in Structural Steelwork for Single Storey Factories. Demy 4to. Pp. 30. 1*s.* net. Wartime Building Bulletin No. 2: The Application of Reinforced Concrete to Wartime Building. Demy 4to. Pp. 10. 6*d.* net. (London: H.M. Stationery Office, 1940.)*

Grinter, L. E. Automatic Design of Continuous Frames in Steel and Reinforced Concrete. Med. 8vo. Pp. viii +141. (New York: The Macmillan Company, 1939.) 12*s.* 6*d.* net.

Neill, Humphrey B. Forty-Eight Million Horses. Med. 8vo. Pp. 253. (Philadelphia and London: J. B. Lippincott Co., Inc., 1940.) 12*s.* 6*d.* net.

Sadler, Walter C. Legal Aspects of Engineering. Med. 8vo. Pp. xix +631. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 24*s.* net.*

Smalley, M. F.; Prentice, A. N.; Buck, H. E.; Wright, W. J.; Kelch, R. V.; Lucal, C. L.; and Bernhard, G. K. Practical Electric Metering. Med. 8vo. Pp. vii +228. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 16*s.* 6*d.* net.*

Chemistry: Chemical Industry

Bray, William C., and Latimer, Wendell M. A Course in General Chemistry. Third edition. Demy 8vo. Pp. xii +206. (New York: The Macmillan Company, 1940.) 7*s.* 6*d.*

Engelder, Carl J. Calculations of Quantitative Analysis. Med. 8vo. Pp. viii +174. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 12*s.* net.*

Gordon, Neil E., and Trout, Jr., William E. Introductory College Chemistry. Second edition. Med. 8vo. Pp. xiii +753. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 21*s.* net.*

Kingzett's Chemical Encyclopædia: a Digest of Chemistry and its Industrial Applications. Revised and edited by Ralph K. Strong. Sixth edition. Med. 8vo. Pp. x +1088. (London: Baillière, Tindall and Cox, 1940.) 45*s.**

Rice, Oscar Knefler. Electronic Structure and Chemical Binding: with Special Reference to Inorganic Chemistry. Med. 8vo. Pp. xiv +511. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 33*s.**

Sand, Henry J. S. Electrochemistry and Electrochemical Analysis: a Theoretical and Practical Treatise for Students and Analysts. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests. Cr. 8vo. Pp. ix +149. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s.* net.*

Snell, Foster Dee, and Snell, Cornelia T. Chemicals of Commerce. Demy 8vo. Pp. viii +542. (London: Chapman and Hall, Ltd., 1940.) 28*s.* net.*

Technology

Charles, David. Photographic Enlarging. Cr. 8vo. Pp. 101. (London: Iliffe and Sons, Ltd., 1940.) 3*s*. 6*d*. net.

Davey, H. T. Wood Finishing. Demy 8vo. Pp. viii + 224. (London: Sir Isaac Pitman and Sons, Ltd., 1940.) 12*s*. 6*d*. net.

Department of Scientific and Industrial Research: Building Research. Technical Paper No. 27: Investigations on Pozzolanas, 1: Pozzolanas and Lime-Pozzolana Mixes. By F. M. Lea. Roy. 8vo. Pp. iv + 64. (London: H.M. Stationery Office, 1940.) 1*s*. net.*

Jenny, A. The Anodic Oxidation of Aluminium and its Alloys. Translated by Winifred Lewis. (Griffin's Technological Handbooks.) Med. 8vo. Pp. vii + 231. (London: Charles Griffin and Co., Ltd., 1940.) 16*s*. net.*

Kerry, W. H., Written and illustrated by (in collaboration with **Stott, E. W.**) Freehand Drawing and Pictorial Illustration for Draughtsmen. Demy 8vo. Pp. 50. (Epsom: The Draughtsman Publishing Co., Ltd., 1940.) 2*s*. net.*

Kinzel, A. B., and Franks, Russell. The Alloys of Iron and Chromium. Vol. 2: High-Chromium Alloys. (Alloys of Iron Research: Monograph Series.) Med. 8vo. Pp. xv + 559. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 40*s*.*

Matthias, A. J. How to Design and Instal Plumbing. 8vo. Pp. 388. (London: The Technical Press, Ltd., 1940.) 18*s*. net.

Townsend, Gilbert. Stair Building, Design and Construction. 8vo. Pp. 200. (London: The Technical Press, Ltd., 1940.) 12*s*. net.

Astronomy

Draper, Arthur L., and Lockwood, Marian. The Story of Astronomy. Demy 8vo. Pp. xi + 394 + 28 plates. (London: George Allen and Unwin, Ltd., 1940.) 12*s*. 6*d*. net.*

Russell, Henry Norris, and Moore, Charlotte E. The Masses of the Stars: with a General Catalogue of Dynamical Parallaxes. (Astrophysical Monographs, sponsored by the *Astrophysical Journal*.) Sup. Roy. 8vo. Pp. ix + 236. (Chicago: University of Chicago Press; London: Cambridge University Press, 1940.) 21*s*. net.*

Meteorology: Geophysics

Benstead, C. R. The Weather Eye. Ex. Cr. 8vo. Pp. 287. (London: Robert Hale, Ltd., 1940.) 8*s*. 6*d*. net.

British Museum (Natural History). John Murray Expedition, 1933–34. Scientific Reports, Vol. 3, No. 4: The Distribution of Organic Carbon and Nitrogen in Sediments from the Arabian Sea. By John D. H. Wiseman and H. Bennett. Roy. 4to. Pp. 193–222. (London: British Museum (Natural History), 1940.) 2*s*. 6*d*.*

Fisk, Dorothy. The Sun, the Sky and Kit. Ex. Cr. 8vo. Pp. 240. (London: Faber and Faber, Ltd., 1940.) 8*s*. 6*d*. net.*

Geology: Mineralogy

Smith, G. F. Herbert. Gemstones. Ninth edition, rewritten. Demy 8vo. Pp. xvii + 444 + 42 plates. (London: Methuen and Co., Ltd., 1940.) 18*s*. net.*

Walton, John. An Introduction to the Study of Fossil Plants. Roy. 8vo. Pp. x + 188. (London: Adam and Charles Black, Ltd., 1940.) 15*s*. net.*

Geography: Travel

Bernard, Theos. Land of a Thousand Buddhas: a Pilgrimage into the Heart of Tibet and the Sacred City of Lhasa. Med. 8vo. Pp. 320. (London: Rider and Co., 1940.) 18*s*. net.

Cornish, Vaughan. The Scenery of Sidmouth: its Natural Beauty and Historic Interest. Demy 8vo. Pp. xiii + 86 + 6 plates. (Cambridge: At the University Press, 1940.) 7*s*. 6*d*. net.*

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GEOLOGY

A Descriptive Petrography of the Igneous Rocks

Vol. I: Introduction, Textures, Classifications and Glossary. By Prof. Albert Johannsen. Second edition. Pp. xxiv+318. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 27*s*. net.

THE publication of Prof. Johannsen's four-volume "Petrography" was completed by the appearance of the last volume in 1938. Notices of the work have appeared in NATURE, **129**, 636 (1932); **132**, 691 (1933); and **142**, 495 (1938). The first volume, dealing mainly with the textures and classification of the igneous rocks, now appears in a second edition.

In his preface to this new edition, Johannsen quotes a statement made by Tom Barth in connexion with certain proposed modifications of rock classifications: "One should always be careful not to spoil a good idea by undue improvements". Apparently adopting this advice, Johannsen has made very few alterations in his revision. Apart from a few minor improvements of the text and additions to the biographies of prominent petrographers, he has been content to make only the following changes. The summary of Hodge's quantitative system of rock classification has been replaced by short accounts of Lacroix's (1933) and Tröger's (1935) systems. A few pages are added dealing with Niggli's (1931) modification of Johannsen's classification and with Andreatta's (1937) modification of Niggli's modification; these few pages are headed with a figure of what appears to be a monkey-wrench—a pleasant gibe which most readers will appreciate. A new appendix, giving the definitions of some 750 rocks described in the other three volumes of the work, has been added, but the other appendixes and tables remain exactly as in the 1931 edition. Teuscher's (1933) method of describing granularity is summarized, and Fersmann's (1928) views on the origin of graphic texture are briefly mentioned. With the exceptions noted, no reference to new work appearing since 1931 is made.

Das Relief der Erde

Versuch einer regionalen Morphologie der Erdoberfläche. Von Prof. Dr. Fritz Machatschek. Band 1. Pp. xi+545+10 plates. (Berlin: Gebrüder Borntraeger, 1938.) 36 gold marks.

NOTWITHSTANDING the title of his great work, "Das Antlitz der Erde", Suess really provided the classic account of the skeleton of the earth's crust. Machatschek proposes to describe the true face of the earth, and to discuss the geological factors that have controlled its development. The whole work will exhibit the relations between the single physiographical units of the earth's surface and the geological-tectonic raw material from which they have been derived. It will be a study in morphotectonics.

This first volume here noticed begins with a few pages of introductory matter, dealing mainly with the classification of the major divisions of the earth's surface. Then follows a treatment of the continental block of Europe and Asia, that is, the part of these continents lying north and west of the Alpide fold-zones. The units of the British Isles, Middle Europe, Fennoskandia, Russia, Siberia, Central and East Asia are dealt with in turn. As an example of Machatschek's method, we may take his account of Fennoskandia; brief summaries of the Pre-Cambrian and Caledonian history are followed by a detailed description of the glacial and post-glacial happenings, and this by a discussion of the topography special to the dozen separate districts into which he divides the region. The second part of the volume deals with the Alpide fold-belt in Europe and North Africa, and treats of the Mediterranean countries.

There are 141 text-figures, many being morphological maps, and ten excellent morphotectonic plates which cover most of the greater regions of Eurasia. The bibliography is selected. The book is good meat for geologists and for those geographers blessed with some geological knowledge.

MATHEMATICAL AND PHYSICAL SCIENCES

The Cyclotron

By Dr. W. B. Mann. (Methuen's Monographs on Physical Subjects.) Pp. xi+92. (London: Methuen and Co., Ltd., 1940.) 3*s*. net.

THE cyclotron is essentially an instrument acting as a source of very high velocity nuclear particles—protons, deuterons, neutrons and alpha-particles—which have been used successfully by physicists in the further study of the constitution of matter by atomic bombardment. Although the fundamental principles of the method were known more than ten years ago, it is during the past few years that the problems involved in the design and construction of practical apparatus have been solved by the work of E. O. Lawrence at the University of California, Berkeley. The author of this little monograph, Dr. Mann, spent a period of two years in Prof. Lawrence's laboratory, and so has been able to describe the principles and some of the possibilities of the cyclotron, as the result of first-hand experience.

After an introductory chapter, a description is given of the phenomenon of magnetic resonance acceleration, upon which the operation of the cyclotron depends. Details of the design of the cyclotron vacuum chamber and the associated magnet are then given, followed by somewhat less satisfactory chapters on the radio-frequency supply, and the adjustments and electric and magnetic focusing arrangements involved. The final chapter, entitled "Applications of the Cyclotron", would appear to be unnecessarily detailed, and much of the material discussed is not concerned with the cyclotron as such but rather with atomic physics and chemistry. This account could have been made more interesting to the general scientific reader, for whom this series of monographs is intended, by confining the description to a few examples, treated more generally. A good bibliography is included at the end of the book.

Advanced Calculus

By Prof. Ivan S. Sokolnikoff. Pp. x+446. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 26*s*.

THE preparation of a book on advanced calculus always entails some difficulty, for, on one hand, essential rigour must not, at this stage, be sacrificed, while, on the other, the course must be sufficiently concrete to appeal to the student and especially to the practical student. There is no doubt that interest in mathematics is often thwarted by a too rigorous presentation of analytical doctrine, and yet even practical students must assimilate an irreducible minimum of valid theory in order to make an intelligent use of mathematics. With these thoughts in mind, it is interesting to turn to Prof. Sokolnikoff's new volume. In the preface, the author admits that the subject is far from easy, but lays down the unalterable aphorism that the solving of problems "is essential to a mastery".

The ideas the basis of which lies in geometry are presented intuitively, whilst proofs of many academic theorems, like those on convergence of monotone sequences; those of Bolzano-Weierstrass, Darboux and a few others, have been wisely omitted, although references to other treatises, where proofs may be found, are given. One very commendable feature lies in the fact that the author has relegated no difficult or essential proof to the exercises provided for the student's practice.

The course embraces the usual topics dealt with in what is generally known as advanced calculus. It begins with limits and continuity; derivatives and differentials; then passes to a full consideration of integration—including definite, multiple and line integrals, and, after two chapters on series, improper integrals. Finally, Fourier series and a simplified formal treatment of some of the important problems arising from the theory of implicit functions are discussed.

The text is written with clarity and is well illustrated both by diagrams and exercises, worked and unworked.

Algebra for Science and Engineering Students

By E. H. Lockwood. Pp. ix+102. (Cambridge: At the University Press, 1940.) 6*s*.

THIS book has been specially prepared for secondary school pupils taking advanced courses in science and engineering. As the author points out, its essential feature is brevity, the aim being to present those parts of the so-called 'higher algebra' which are essential for sixth form pupils, on the science and engineering side, who do not offer mathematics as a main subject. The course begins with indices, logarithms and surds, then passes to variation; the theory of quadratic equations; factors and their development, including cyclic symmetry and partial fractions; permutations and combinations, leading to the binomial theorem for a positive integral index. The remaining part of the volume is devoted to the elements of simple probability, series and an introduction to statistics. A few practical applications of some of the principles explained in the text are given among the exercises provided for the student to solve.

The deliberate brevity of the treatment renders the text, particularly in the earlier chapters, almost a summary—and a good summary too—of the algebra needed for a sound training in what, a few years ago, would have been called the non-mathematical sciences, and, judging by the preface, the author has the biology student especially in mind, for he states: "Biology is becoming every day more mathematical." The treatment of the latter part on probability and statistics is much fuller and interesting, and should prove a welcome introduction to these subjects.

The book is certainly valuable for its purpose and is well illustrated both by line drawings and exercises to which answers are given. In the case, however, of engineering or physics, is not a full course in mathematics, taken to main subject standard, essential?

Electricity and Magnetism for Students

By S. R. Humby. Pp. 319. (London: John Murray, 1939.) 6*s*. 6*d*.

THIS excellent book is intended mainly for students who are preparing for entrance scholarships to the universities, and the Higher School Certificate and University Intermediate examinations, while it also covers a lot of the ground necessary for an ordinary degree. One of the many good features of the book is the flexibility of the treatment given, for as the author says in his preface, "Each chapter gives a complete, though necessarily limited, discussion of its part of the subject"; this means that the chapters may be dealt with in any order to suit requirements, and though in the book the work on electrostatics is separated from that on current electricity by the long chapter on magnetism, the author does not suggest that this sequence should be rigidly adhered to.

Mr. Humby has kept the needs of the students well in the forefront, and his courage in concentrating on one aspect of a theory which can be approached by several methods is to be commended, and will no doubt be greatly appreciated by students.

The author claims to have made a special effort to resolve the difficulties of magnetic induction, and it must be said that the skilful way in which he has developed this theory in the same chapter as other magnetic phenomena, instead of making it appear more formidable by devoting a separate chapter to it, seems to have justified his claim. Another pleasing feature is the logical sequence adopted in connexion with conduction of electricity, the conduction in solids, liquids and gases being dealt with in successive chapters.

Altogether it is an up-to-date book, well produced on very sound lines, and it should be found very helpful by students.

Household Physics

By Walter G. Whitman. Third edition. Pp. vii+436. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 18*s.* net.

THIS book, now in its third edition, deals with the practical applications of physics with particular reference to the home. The general plan of the first edition has been retained, but many changes have been made and six new chapters have been added, including one on air-conditioning.

Throughout the book the everyday experiences of students are used as a base from which to develop the concept of the fundamental laws of physics; there are twenty-eight chapters embracing examples in all the main branches of the subject, and since the whole is so comprehensively treated, the author has found it impossible to give great detail. Many very clear diagrams are included, and at the end of each chapter a useful summary of the main points is given, also a few suggestions for further study.

The book will provide interesting and instructive reading to both boys and girls, whether they are proceeding to a more academic treatment of the subject or not, and certainly a greater knowledge of the underlying principles and the operation of many devices found in the modern home will be of benefit to all. The student must be warned, however, that in some cases the author has been compelled, owing to lack of space, to give a necessarily condensed and incomplete theory; this is sufficient for ordinary purposes, but the student who is interested in pure physics will wish to go more deeply into such theory.

MISCELLANY

Acute Infectious Diseases

A Handbook for Practitioners and Students. By Dr. J. D. Rolleston and Dr. G. W. Ronaldson. Third edition, revised and enlarged. Pp. ix+477. (London: William Heinemann (Medical Books), Ltd., 1940.) 17*s.* 6*d.* net.

THE third edition of Rolleston's work, now under dual authorship, maintains the high standard of previous editions. The book is well produced, and, considering the amount of information supplied, is very convenient to handle. The absence of clinical illustrations, to which reference is made in the preface to the first edition, is amply compensated by the graphic description given of the cutaneous lesions of the acute exanthemata. It is unusual in a work of this size to find an attractive historical summary of each disease and also a serviceable bibliography. The source is a guarantee of scholarship and accuracy.

At a time when infectious diseases are specially liable to occur, the publication of such a book is opportune, for it offers to all, whether in the Services or in civilian practice, a reliable guide on all matters of treatment and prevention. Since the publication of the last edition, chemotherapy has revolutionized the treatment of certain infectious diseases, the use of serum in treatment and prevention has been extended, and much work has been done with regard to immunization, more especially in the virus diseases. All these subjects have received a detailed consideration which will be of value to the practitioner. Two additional chapters deal with erysipelas and isolation methods. The former is opportune as erysipelas is an excellent example of a disease amenable to both serum treatment and chemotherapy. The last chapter, with plans of modern isolation blocks, will appeal to all who are interested in administration.

The Annual Register

A Review of Public Events at Home and Abroad for the Year 1939. Edited by Dr. M. Epstein. Pp. xiv+507. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 30*s.* net.

IT is seemly that an annual volume that now makes its hundred and eighty-first appearance should be published at the accustomed time and should maintain its normal size and all its normal features. As usual, more than half the volume is a review of world history with special regard to Great Britain and the British Empire. The year was one of preparation for war in most lands, but, as events have shown, a preparation that proved too leisurely even during the last four months of the year. Other European States receive full consideration, and the enigmatic attitude of the Soviet Union is revealing. The second part of the volume has the usual chronicle of events, obituaries and retrospect of art, science, literature and finance. The review of science directs attention to an unusually prolific year in biological publications and great advances in many aspects of that subject. Several important public documents are printed in full. They include the agreement with Poland, the treaty of mutual assistance between the United Kingdom, France and Turkey, the Russo-German pact and the various Soviet pacts with the Baltic States.

PHILOSOPHY

Causality and Science

By Prof. Nalini Kanta Brahma. Pp. 120. (London: George Allen and Unwin, Ltd., 1939.) 6*s.* net.

AS an ultimate assumption of science, the principle of causation is capable of a metaphysical analysis. Deploring the rejection of final causes by modern science, Prof. Brahma believes that the present interpretation of physics has not come to stay. For example, he questions that the indeterminism in the effect proves the indeterminism in the cause; and he contends that the idealistic view of physics is more superficial than fundamental. Moreover, scientific causality, whatever be its interpretation, is always partial, as it does not cover the other realm of values which give colour to life. The author rejects the mechanistic as well as the organic theory of causality. He holds that a cause is neither a sum total of conditions nor an implication of the whole effect latent in itself. For in both cases, causality lacks purpose, intelligent direction and plan, the essentials of real creativity. In order to account for heterogeneous variations, it is necessary to assume an absolutely perfect cause; in essence, a creative will. This conclusion, which is in line with the Hindu notion of change as illusory, brings us into the field of metaphysics. But the discussion of the various conceptions of causality is a valuable addition to the critique of scientific method and of its implications.

T. G.

Charles Peirce's Empiricism

By Dr. Justus Buchler. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvii+275. (London: Kegan Paul and Co., Ltd., 1939.) 12*s.* 6*d.* net.

DR. BUCHLER'S clear presentation of Peirce's empiricism is extremely welcome. Peirce was a fertile and original thinker of no mean order; his work is too little known in Great Britain, but Dr. Buchler's book should introduce it to English readers. The task could not have been easy. Peirce was unsystematic in his thinking and fragmentary in his writings. Nevertheless, he is worth the labour of piecing together his disjointed reflections. His contributions to symbolic logic are of permanent value, and his conception of methods of inquiry and of establishing beliefs forestall much of the work that we associate with the names of Carnap and Wittgenstein. This is a book to be recommended.

STATISTICS

Statistical Mathematics

By Dr. A. C. Aitken. (University Mathematical Texts.) Pp. vii+153. (Edinburgh and London: Oliver and Boyd, 1939.) 4*s.* 6*d.* net.

THE recent appearance of several works on probability and statistics within a short time may suggest that they must overlap and that the subject is receiving undue attention. But on the contrary, while they are a sign of widespread interest, they differ sufficiently in aim and treatment to make them supplementary in a genuine sense. The subject can be approached from different points of view, and it has enough vitality to make the day far distant when a single text-book will be found satisfying.

This little book is so excellent and at the same time so inexpensive that it should be added to their collections by all who are interested in the methods of probability. It is a marvel of compression, but it must be understood that this result is due partly to a judicious choice of topics and partly to the consistent use of a general method. Its leading feature, in fact, is the introduction of the generating function in its several most important forms. By this means Dr. Aitken has succeeded in combining elegance and brevity without sacrifice of lucidity, though the less instructed reader may still find a more leisurely and pedestrian line of approach more congenial at an early stage. The book is naturally devoted mainly to the principles of statistics, but space is found for numerical examples fully worked and even for some explanation of modern statistical technique.

Statistical Methods

For Medical and Biological Students. By Prof. Gunnar Dahlberg. Pp. 232. (London: George Allen and Unwin, Ltd., 1940.) 10*s.* 6*d.* net.

G. DAHLBERG'S new book will be a disappointment to those who appreciated his excellent book on twins (1926). Its aim, to present statistical methods in a form calling for no special knowledge of mathematics, but at the same time to give some idea of the concepts on which these methods are based, is practically the same as D. Mainland's "The Treatment of Laboratory and Clinical Data"; but, whereas Mainland gives detailed explanations of the tests of significance most frequently used, even the *t* test finds no place in Dahlberg's book. It is puzzling that it should be published in 1940. R. A. F.

Tables of Random Sampling Numbers

By M. G. Kendall and B. Babington Smith. (Tracts for Computers, No. 24.) Pp. x+60. (Cambridge: At the University Press, 1939.) 3*s.* 9*d.*

AN early publication of the Department of Statistics, University College, was Tippett's series of random sampling numbers (1927), regarded by many at first as a most eccentric sort of publication. With the introduction of randomization as an experimental precaution, this table was soon found to save a great deal of time, and many laboratories provided themselves, for their own use, with additional random series. The recent "Tract for Computers" contains a hundred thousand new numbers.

R. A. F.

Tests of Significance

What they Mean and How to Use Them. By John H. Smith. Pp. ix+90. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 6*s.* net.

J. H. SMITH'S pamphlet is an indication that the teachers of business administration, like those of psychology and education, are becoming aware of the modern movements of statistical thought. The treatment seems clear and sound, and the ground covered is no more than that needed by all students of statistics. R. A. F.

A Bibliography of the Statistical and Other Writings of Karl Pearson

Compiled by G. M. Morant, with the assistance of B. L. Welch. (Issued by the *Biometrika* Office, University College, London.) Pp. viii+119. (Cambridge: At the University Press, 1939.)

MORANT'S bibliography of Karl Pearson covers 648 items from 1879 to 1935. Short annotations are given in some cases, but for the student of the history of statistics these are too colourless to be helpful. The work is an unsparing labour of love.

R. A. F.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

Glasgow, where he was trained as an anatomist by Prof. John Cleland, whose senior medallist and junior demonstrator he was. He graduated with honours M.B., Ch.B. in 1907 and was Brunton Memorialist of his year. After a year in private practice he became senior assistant to Prof. T. H. Bryce in his old University. In 1915 he received the Bellahouston and Struthers gold medals for his M.D. thesis on "The Scottish Skull", and was in the same year appointed by the Medical Research Council to work under the late Dr. John Brownlee on the stupendous task of compiling and analysing a case record and card-index of all officers and men admitted to hospital during the War of 1914–18. This work, which was not completed until 1922, involved the preparation and arrangement of 22 million index cards and the analysis of a million and a quarter medical case sheets. This material was taken over by the Ministry of Pensions.

Young continued on the staff of the Medical Research Council until 1927, when on the death of Dr. Brownlee and after taking the D.P.H. of Cambridge, he was transferred to the external staff and by a special arrangement was attached to Elliot Smith's department at University College, London, holding the position of lecturer in anatomy. This was perhaps the happiest and most fruitful period of his life. It gave him the opportunity he had long desired, to return to his studies in anatomy and anthropology, as well as of exercising his powers of statistical analysis, of which he had first given assured evidence in his thesis on the Scottish skulls, and had further demonstrated in statistical papers, some twenty in number, published during 1920–27 and including studies in epidemiology and the incidence and mortality of cancer. It has been said that Young's work substantially raised the standard of medical research in Great Britain by insisting on the proper biometrical treatment and interpretation of numerical data. Further, his work at University College in congenial surroundings gave full scope to those sound, if unobtrusive qualities, of which the most highly valued was his constant readiness to place his abilities and his profound knowledge at the service of colleagues and students alike. He was invited to join the committees of the Medical Research Council on dental disease and statistics. In connexion with the work of the former he published a study of the relation of dietary deficiency to dental disease, dealing with data collected in Birmingham under the auspices of the committees.

As anatomist and anthropologist, Young published numerous papers, perhaps half in collaboration with others; and it is no exaggeration to say that several of these of considerable value would never have been written had it not been for his encouragement and readily offered assistance. He was particularly interested in the problems of facial growth with reference to the development of dentition. One of his most important contributions to the subject was a study of the growth of face and jaws in children, which with other work gained him the D.Sc. of the University of Edinburgh. More directly anthropological studies were his collaboration with Sir Grafton Elliot Smith in the study of the London skull known as "The Lady of Lloyd's".

Mr. H. Higgs

Henry Higgs, who died on May 21, belonged to that type of economist of which John Stuart Mill was the leading example in an earlier generation, the economist public servant. Born in 1864, he entered the Post Office secretariat in 1884; was transferred to the Treasury fifteen years later; and served as private secretary to a succession of statesmen. He retired from the Treasury in 1921; was for a time lecturer in economics at Bangor and, for the ten years, 1929–39, was occupied mainly with work on the "Economic Bibliography", of which a first volume appeared in 1935.

While at the Treasury, Mr. Higgs was the first secretary of the Royal Economic Society and joint editor of the *Economic Journal* from 1892 until 1906. He had special knowledge of the thinkers of the eighteenth century; and his work on Cantillon and the Physiocrats was of a high order. His position at the Treasury enabled him to write with authority on questions of public finance. But, as his editing of Jevons's "Principles of Economics" (1905) and his repeated tenure of the Newmarch lectureship in statistics show, there was no aspect of economic thought with which he was not in contact.

Besides, Higgs had served as Inspector General of Finance in Egypt (1912–15) and had done other specialist work for the State. This made the range of his scholarship the more remarkable and explains the fact that, in spite of it, his learned output was rather fragmentary—the product of the hardly secured leisure of a very busy man. Some of the editorial work with which he was engaged after his retirement from public and academic activity was not of the kind to bring him much added reputation, and not all of it was equal to the work of his prime. In these last years he was, however, handicapped by failing health and almost complete deafness, which isolated him somewhat from colleagues and friends.

We regret to announce the following deaths:

Prof. W. F. Bork, emeritus professor of psychology in Indiana University, on May 22, aged sixty-six years.

Prof. A. Fowler, C.B.E., F.R.S., emeritus professor of astrophysics in the Imperial College of Science and Technology and in the University of London, and formerly Yarrow research professor of the Royal Society, on June 24, aged seventy-two.

Dr. Phyllis Tookey Kerridge, formerly lecturer in physiology, University College, London, on June 22.

Dr. Alvin S. Wheeler, emeritus professor of organic chemistry in the University of North Carolina, on May 12, aged seventy-three.

Prof. F. J. E. Woodbridge, emeritus Johnsonian professor of philosophy in Columbia University, on June 1, aged seventy-three.

NEWS AND VIEWS

Salvage and Utilization of Waste

A LEADING article in this issue of NATURE (p. 988) is devoted to a discussion of certain aspects of the salvage and utilization of waste. It is interesting to note that the sixth report issued by the Select Committee on National Expenditure consists of the conclusions reached by a Sub-Committee on Supply Services which has investigated the relation between the work of the Ministry of Supply and the Office of Works. These two departments are responsible for the provision of stores of various kinds, and, working independently as they do, they tend to compete with each other, thus causing unnecessary confusion.

The report recommends the appointment of a national controller of salvage, who shall direct the work of an inter-departmental committee which shall supervise the salvage work of all departments. A more intense publicity campaign for the salvage of waste products is recommended, and, in particular, it is suggested that the virtues of refuse dust as a fertilizer be made more widely known with the help of the Ministry of Agriculture and the National Union of Farmers. There is urgent need, too, for closer co-operation between the Salvage Department and the County War Agricultural Committees. This is particularly necessary in the important matter of the disposal of kitchen waste suitable for the feeding of pigs. There is no questioning the need for the appointment of a national controller of salvage with full power of co-ordination. The sooner the appointment is made, the sooner will the nation be in a position to use its so-called waste products effectively.

The Linnean Society during War-time

AT the anniversary meeting of the Linnean Society held on May 24, the retiring president, Dr. J. Ramsbottom, delivered his presidential address, the substance of which appears elsewhere in this issue (p. 993). Discussing the affairs of the Society, Dr. Ramsbottom said it was decided that at the beginning of the War it was not only in the best interests of the Society but also of biological science that the Society should remain in Burlington House. No matter what happens it is hoped that the present policy shall continue. The Linnean collections, the Smithian collections and certain other irreplaceable belongings have been removed. Thus all reasonable precautions with the Linnean collections have been taken; but what if they should meet with disaster ? During the time the collections have been away abundant evidence has been shown of the difficulties which arise when the Linnean Herbarium and the insect collection cannot be consulted. The Society has the negatives of photographs taken at various times of numerous specimens. Would it not be advisable to have photographs of the whole of the specimens taken under botanical or zoological supervision ? Prints could be sold to anyone and complete sets might be kept in one or two places : or it may be that reproductions could be published. It would be advisable also to photograph all the types in the Smithian Herbarium. There would be no point in publishing these, but records that can be preserved in safety would be available. The problem of manuscripts should also be considered. Would it not be wise to have microfilms or photostats of the Linnean correspondence and all important unpublished manuscripts in the Society's possession ? These again should be distributed.

Amateurs in Natural History

At the 150th anniversary meeting of the Society it was shown that it regards natural history societies as workers in the same field. Many prominent fellows of the Society are keenly interested in their local natural history societies. Dr. Ramsbottom thinks it would be well if the Society encouraged the idea that election to the Linnean Society of London should be the hall-mark of excellence in the study of natural history. If this were so the Society would continue to have that leaven of the amateur which is so necessary to the well-being of the Society. Amateurs were in the past the very backbone of British biology : it would be a sad blow to the democracy of science, even to science itself, if the Linnean Society were ever to be regarded as a domain reserved for the professional worker. "As a Society, then, our task during the War is to carry on as normally as possible, and to help others to do the same. In this connexion the Council has agreed to bring forward a motion, similar to one passed during the last War, that refugee biologists should be allowed certain privileges such as permission to attend meetings and to use the library".

H.M. Forces and Natural History

As individuals, fellows of the Society may have an opportunity of doing something, though not in a very spectacular way. There are many in H.M. Forces who might be helped over difficult periods if they became interested in natural history. Many of these men are seeing the common plants, birds and insects of the countryside for the first time, others in circumstances when their interest is easily aroused. Entertainment of the troops is usually of a certain type, excellent in its way, and nowadays the most popular of its kind. But some need more than mere amusement. It is not a matter of previous education but of temperament. The need may be met with music, or poetry, or other literature; for some it is in natural history. What can one say in answer to a letter asking whether the enclosed flower is a cowslip ? It may be to settle a bet—but it at least shows an interest and it is up to us to encourage any such interest, not with the intention of popularizing our special subjects, or for any other purpose whatsoever beyond helping these men to think of things other than evil ones. There is no need to organize such efforts. The more informal they are the better. Dr Ramsbottom suggests that any fellow who is prepared to help in this direction should get into touch with the Y.M.C.A. or similar organization at the nearest camp; or with the padres at the military hospitals. Here they will find a knowledge of individuals which is amazing, and an offer to talk to one or two men or to give a lecture on some aspect of biology which has a popular appeal will invariably be accepted.

Chair of Electrical Engineering, Birmingham

THE chair of electrical engineering in the University of Birmingham, vacated by the resignation of Prof. B. L. Goodlet, has been filled by the appointment of Dr. Cecil Dannatt. Dr. Dannatt has had many years experience with the Metropolitan-Vickers Electrical Co., Ltd., at Manchester, especially in the Research Department, where he has for some time been in charge of the Electrical and Magnetic Laboratory. His work has brought him into close contact with various branches of the industry and has given him opportunities of judging the needs and capabilities of young men in training for routine work and for research in electrical engineering. In the 1938–39 session, Dr. Dannatt was part-time lecturer in electrical engineering at Queen Mary College, University of London. Prof. Goodlet, who only took office in November last, resigned in order that he might make more effective use of his capacity in war-work elsewhere.

Books in War-time

IN NATURE of May 11, p. 719, we put forward the plea that books should not be subject to the proposed purchase tax. It has now been announced that on June 21 the Chancellor of the Exchequer received a deputation in this connexion composed of representatives of the church, literature, science, and education. The deputation consisted of theArchbishop of Canterbury (who introduced the deputation), Sir Arthur Eddington, Lord Hambleden, Mr. A. P. Herbert, M.P., Prof. A. V. Hill, Dr. Albert Mansbridge, Mr. J. B. Priestley, Sir Charles Grant Robertson, and Prof. R. H. Tawney. The Bishop of Chichester and Sir Will Spens were unavoidably prevented from attending. The deputation was accompanied by Mr. Geoffrey Faber and Mr. G. Wren Howard, president and vice-president of the Publishers' Association, and Mr. Stanley Unwin, chairman of the Books and Periodicals Committee of the British Council.

Pest Control Chemicals

AT a recent meeting of interested firms, the Pest Control Chemicals Export Group was formally inaugurated, with headquarters at 166 Piccadilly, London, W.1. The Group has now received the recognition of the Export Council of the Board of Trade. The broad object of the Group is to promote the export trade in such chemicals. Any British persons, firms or bodies corporate actively engaged in the manufacture and export of pest control chemical products, such as (a) disinfectants, (b) sheep and cattle dips, (c) agricultural insecticides and fungicides and (d) animal medicines and allied products are eligible for membership of the Group. The main Group comprises four autonomous sub-groups to deal with the problems arising from each of these sections of the industry. Thirty-six firms have already signified their intention of joining the Group. The first problems of the Group will be in connexion with materials in short supply.

Evulsion of Front Teeth in East Africa

IN reference to recent comment in NATURE (April 20, p. 631) on Dr. Aleš Hrdlička's study of the practice of removing the front teeth found among primitive peoples, Dr. Frank Marsh, c/o Anglo-Iranian Oil Co., Ltd., Pathological Laboratory, Abadan, Iran, suggests an alternative to the ritual origin of the custom, based upon his experience in British East Africa. There, he points out, the practice of removing the incisors is almost entirely confined to the Masai and related tribes. These tribes are warrior castes who under their natural (pre-controlled) condition lived by and for fighting; and in the course of this pursuit they expected to receive wounds, especially from arrows carrying poison derived from putrescent flesh. The juices of putrefaction contain large numbers of the spores of *Clostridium tetani*, causing lockjaw. The victim is then fed on milk and other liquids introduced through the toothless gap. Some recover—a result rare among civilized peoples. Dr. Marsh suggests that this may be a definite practical reason for the ritual removal of the teeth.

While it is unquestionable that practical experience of the kind to which Dr. Marsh refers would tend to perpetuate the practice in a given group of people, its influence probably is secondary. Various reasons are given by peoples who follow the practice; for example, it may be related to the escape of the soul from the body at death; while it is too widely distributed in time and space—it occurs among the mesolithic peoples of Palestine and North Africa—for it to be likely that a single practical purpose is implicated in all the varying conditions alike.

The Populations of Southern Algeria

DR. MAURICE GRONIER devotes his inaugural thesis (*Thèse de Paris*, No. 163; 1940) to the anthropological features and peculiarities of disease of the inhabitants of southern Algeria. The Arab population is characterized by a fairly high average stature, distinct dolichocephaly and leptorhinia, while the Mzabite population is distinguished by a higher stature, a relatively long trunk, a tendency to mesocephaly and a higher nasal index. The dentition of these populations is remarkably good, there being an exceedingly low percentage of caries. In addition to widespread malaria, parasitic invasion of the skin and alimentary canal and especially trachoma, the points in which the natives of southern Algeria show a striking contrast with Europeans are as follows:

the absence of the nervous complications of syphilis in spite of the prevalence of that disease, the low incidence of diseases of the liver, the rarity of appendicitis, the frequency of pain in the region of the solar plexus, the prevalence of the osteo-articular and glandular forms of tuberculosis and the frequency of cataract in elderly persons.

Euthanasia

IN the April issue of the *Quarterly Review*, Sir Arthur Hurst discusses the question of euthanasia from a practical point of view without any sentimental considerations. Those in favour of the practice, he points out, maintain that euthanasia should only be carried out on persons who are affected with an incurable and painful disease, which cannot be controlled by any form of treatment. On the other hand, the cases in which euthanasia appears most desirable do not come within the scope of the Euthanasia Act, which requires the expressed desire of the patient that his life should be ended. Such cases are those of new-born babies with severe deformities or conditions preventing normal mental development, or that of the intelligent man who becomes paralysed and is unable to communicate his wishes by speech or writing.

Sir Arthur condemns the unjustifiable confidence displayed by the advocates of euthanasia in the ability of two independent medical advisers, however experienced they may be, to decide whether a disease is incurable, and quotes several examples of patients condemned to death by eminent physicians or surgeons making an unexpected and complete recovery. In undoubted cases of incurable and painful disease, in which no relief can be obtained except by morphia, Sir Arthur recommends that the patient should be kept permanently free from pain by gradually increasing the dose and giving the injections as often as is necessary. Moreover, pain can be controlled not only by drugs but also by surgical operation, which is particularly indicated when the painful disease is not likely to be rapidly fatal and the administration of morphia is therefore undesirable.

Photo-cell Applications in the Foodstuffs Industries

IN commerce the difference between one quality of rice and another consists mainly in the proportion of discoloured grains present. Since hand-sorting has never been commercially practicable, the mechanical and electrical method of sifting out the discoloured grains by a machine, described in a paper by A. Seymour in the *Electrical Times* of June 6, may have far-reaching effects. The machine utilizes the properties of a photo-cell. By an ingenious mechanical method, the grains emerge from the feeder in a single line at a speed of 5 ft. per sec. and pass under the electric 'eye'. The perfect grains shoot straight forward into a tube leading downwards to a sack. Discoloured grains cause an electrical impulse through the photo-electric cell; this brings into action a jet of compressed air, which sends them into another receptacle.

Examination of granulated sugars is more elaborate, as it includes a classification of the finished sugars for general appearance and an evaluation of the colour and turbidity of the sugar solutions. Experiments with photo-electric apparatus have shown that good correlation exists between the appearance of a sample of granulated sugar and its reflectance relative to magnesium oxide. A specially designed optical system in the photo-electric apparatus permits measurements of the transmittancy of sugar solutions as well as of the reflectance of the sugar in granulated form. Numbers obtained from these data enable the expert to compare the relative merits of the samples.

The Edinburgh Botanic Garden

A PAPER by John M. Cowan (*J. Roy. Hort. Soc.*, 65, Pt. 3; March 1940) describes the various botanical personalities who have contributed thought and organization to the development of the Royal Botanic Garden, Edinburgh. This is one of the oldest 'physic' gardens in Britain, and was established in 1670 by Robert Sibbald, with help from his friends Andrew Balfour and Patrick Murray. The first 'intendant' was James Sutherland, whose subsequent appointment as the first professor of botany at the University of Edinburgh ensured that close co-operation between academic plant science and practical horticulture which has been so marked a feature of the institution throughout its history. The Prestons, Charles Alston and John Hope succeeded Sutherland, each adding patiently a solid quota of work. Rutherford, discoverer of nitrogen, was also in charge of the garden, and more recently, J. Hutton Balfour and Sir Isaac Bayley Balfour have enhanced the reputation of the garden as an academic centre. It now possesses modern laboratories, and provides a stimulating part of the curriculum for students in medicine, arts, pure science, forestry and agriculture.

Road Obstruction Lanterns

THE General Electric Co., Ltd., has developed a road obstruction lantern which complies strictly with the Lighting (Restrictions) Order, 1940. The use of these electric lanterns for fixing to street bollards or other supports has many advantages. Not only does it mean a saving ranging from 2*d*. to 6*d*. per lamp per day, but it also saves in oil and man-power. According to *Roads and Road Construction* of June 1, in one London borough alone the saving effected in this way amounts to nearly £5,000 a year. The G.E.C. lantern is constructed of lead-coated sheet steel and has three sides, stencilled with the approved St. Andrew's Cross sign and backed with white opal glass. Inside are a detachable baffle and a B.C. lampholder for use with a 15-watt pearl Osram lamp. This provides the correct amount of light (0·5 candle per square foot) on the crosses. The lamp is easily accessible for wiring and maintenance. The lantern is supplied finished with either black or white outside. A two-lamp unit is preferred by some authorities because of the advantages of ensuring that there is a light on the island even if one lamp fails. The cost of the G.E.C. two-lamp lantern is little greater than that of the standard unit.

arthquakes during May 1940

URING May 1940, eighteen earthquakes were tered at the Swiss Seismological Observatories asle, Chur, Neuchâtel and Zurich. The observers rich have estimated the epicentres of the larger s as follows : May 1, in the province of Parma aly ; May 4, in the Pacific Ocean east of the chatka Peninsula near lat. 50° N., long. 170° E. ; 7, in Anatolia near lat. 42° N., long. 34° E. ; 19, one again near the Kamchatka Peninsula t lat. 49° N., long. 158° E., and one possibly in Indian Ocean ; May 24, one near Lima in Peru, one in Central Germany.

e United States Coast and Geodetic Survey, in eration with Science Service and the Jesuit nological Association, has made a preliminary mination of the epicentres of the earthquakes ay 11 and 17. On twelve seismometric reports picentre of the shock of May 11 was calculated near lat. 53·2° N., long. 172·0° E., which is near sland of Attu at the extreme western end of the tian Islands. On the basis of instrumental rts from Fordham, Ottawa, Weston, Pittsburg, Louis, San Juan, and Huancayo, the epicentre e earthquake of May 17 turned out to be near 7·9° N., long. 81·8° W., which is just in the ic Ocean off the coast of Panama to the south- of Pueblo Nuevo. Most of these shocks were recorded at Kew.

Night Sky in July

N July 1, the duration of night (sunset to sunrise) ne latitude of London is 7·5 hours ; astronomical light (the sun not greater than 18° below the izon) lasts all night until July 21. The moon is on July 5 and full on July 19. The moon is in unction with Mars on July 6, with Jupiter and rn on July 28 and with Venus on July 31. From western parts of North America, Venus will be to be occulted by the moon at this conjunction laylight. There is no bright planet conspicuous in the evening skies, since Mars—the remaining mber of the notable group of bright planets seen the evenings of the early part of this year—is ting too close to the sun for observation. At the ginning of the month, Jupiter and Saturn rise thin a quarter of an hour of each other not long r midnight (U.T.). Venus is the bright morning seen about one hour before sunrise in the middle July and 2½ hours before sunrise at the end of the nth. The planet is increasing in brightness towards maximum on August 2. Close groupings of piter's four inner satellites (to be seen with oculars) occur about 2h. on July 2, 12, 20, and 21. e ring system of Saturn is well open, the minor s of the outer ellipse of the outer ring being greater n 13″. The delta Aquarid meteors reach a ximum frequency about July 28.

ouncements

T its meeting on June 21, the Council of the er Institute appointed Prof. C. R. Harington one of its representatives on the Governing Body of the Institute in succession to the late Sir Arthur Harden.

THE Royal Meteorological Society has awarded its Howard Prize (an aneroid barometer, given annually for the best essay on a selected meteorological subject) to Cadet S. R. Pryor of the S.A.T.S. *General Botha*. The subject of the essay was "The Relation of Wind to Ocean Currents".

AT the annual general meeting of the Royal Geographical Society, it was announced that the King, having approved the awards of the Founder's and Patron's Medal, had signified through the Keepers of the Privy Purse that the gold medals could not be struck until after the War. The complete list of the Society's awards was given in NATURE of April 27, p. 665.

THE annual general meeting of the British Social Hygiene Council will be held at British Medical Association House, Tavistock Square, W.C.1, at 4.30 p.m. on July 8. The president, Sir Walter Langdon-Brown, will deliver an address on the activities of the British Social Hygiene Council since the outbreak of war. Tickets of admission may be obtained on application to the Secretary, B.S.H.C., Tavistock House South, Tavistock Square, W.C.1.

DR. E. H. CLUVER, secretary for public health and chief health officer for the Union of South Africa, has been appointed director of the South African Institute for Medical Research in succession to the late Sir Spencer Lister.

THE Plunket Society or Royal Society of New Zealand for the Health of Women and Children is proposing to erect a monument to its founder, Sir Truby King, whose system of infant feeding largely contributed to making the infantile mortality in New Zealand the lowest in the world.

A GIFT of a thousand dollars has been made to the International Association for the Prophylaxis of Blindness to promote research in ophthalmology. The subject chosen for a prize, which will be awarded on the occasion of the tenth International Congress of Ophthalmology, is simple non-inflammatory glaucoma. The address of the Association is 66 Boulevard Saint-Germain, Paris.

A PROGRAMME of some thirty papers on the applications of spectroscopy to problems of biology, chemistry, geology, metallurgy, medicine, physics, and various industries, has been arranged for the eighth summer conference on spectroscopy and its applications, to be held in the George Eastman Laboratories of the Massachusetts Institute of Technology during July 15–17. Further information can be obtained from Prof. George R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1024.

First Use of Current-Bedding to Determine Orientation of Strata

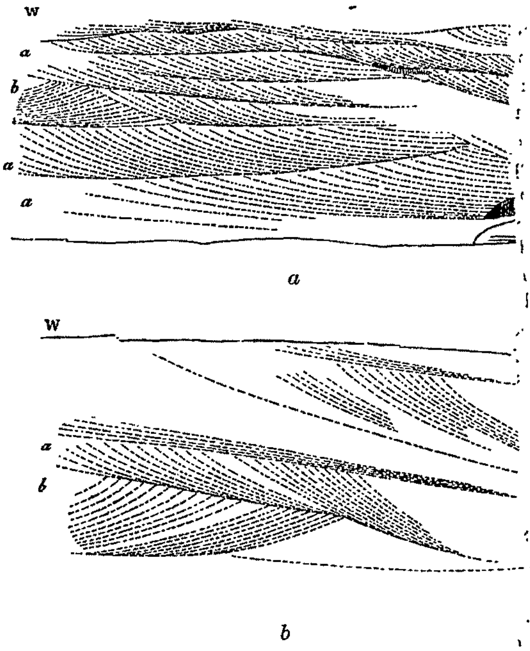
DR. ROBERT M. SHACKLETON[1] has recently completed a revision of the structures of the Silurian and Devonian rocks of the Dingle Peninsula and Blasket Islands in south-west Eire. In this he has used the positions of truncated tops and asymptotic bases of current-deposited laminæ in order to determine the correct order of succession, and has been able to demonstrate the probable equivalence of Anascaul Beds with Ferriter's Cove and Croaghmartin Beds (Silurian) and of Smerwick Beds with Dingle Beds (Downtonian). Axes of folding that trend from east-north-east to west-south-west have been plotted, and inverted beds are conclusively recognized on the north and south margins of the Peninsula and at Clogher Head. The final proof that the axis of an overfolded syncline runs through Ventry Harbour, Fahan Point, and between the Great Blasket and the two smaller islands of Inishnabro and Inishvickillane, vindicates the work of G. V. Du Noyer prior to 1859 in first tracing the inversion south of this important line and describing it despite opposition by J. Beete Jukes[2], director of the Irish Geological Survey.

It is also of interest from the historical point of view to recall that it was from the Dingle Beds, at Slea Head, facing the Great Blasket, so early as 1864, that figures of false-bedding, used to decide which way up strata were lying, were published by John Kelly[3]. He concluded from the diagrams reproduced in the accompanying figure that at Slea Head the beds had their original tops orientated upwards, and showed that successive sets of laminæ were deposited by currents flowing at different times from approximately opposite directions. Kelly's conclusions have now been fully supported, so that it may be opportune to quote part of his pioneer description :

"In the laminæ of that part of the bed marked *a*, the thick end of every minor layer is uppermost, the fine point at the bottom and the curve downwards. In this case the view at Slea Head is taken so that the observer is looking towards the north, and it is evident that the current which brought the grains of sand to form the groups of laminæ *a*, *a*, *a*, came from the west; the current that brought and deposited the group *b* came from the east. . . .

". . . another sketch taken on the south coast of Slea Head, at Reenrooig . . . is of similar character . . . but in this case nearly all the sediment was brought from the west, only one group appearing to have come from the east. . . .

"This fact of the thick end of the laminæ of deposition being up and up stream, and the point downwards and down stream . . . is important, inasmuch as from it we may know . . . what side of a bed was uppermost when it was deposited, and thus



SCALE : THREE FEET TO ONE INCH.
CURRENT-BEDDING IN COARSE BROWN GRITS (DIN
BEDS) SHOWING STRATA RIGHT WAY UP AT RE
ROOIG (*a*) AND LACKLETTERA (*b*), NEAR SLEA HE
DINGLE PENINSULA. (AFTER JOHN KELLY, 18

in the Silurian and Devonian beds of the sout
Ireland, it may be known where steep dips or c
plex contortions present themselves, whether
original upper side of a bed is still uppermost,
whether a group of beds has been overthrown
turned upside down, as is sometimes the case.

"These facts were noticed by Mr. Patrick G
who made numerous drawings of this kind of la
tion about Slea Head for Sir Richard Griffith."

John Kelly goes on to describe the relation bet
ripple-marks and false-bedding. His account
matured one, so that probably the results date f
some years earlier than the time of publicatio
1864. The author seems to be the same perso
the J. Kelly engaged as an assistant geologist al
with Du Noyer in the survey of Dingle. Ther
therefore, little doubt that these remarkably mo
views were known in Ireland when the Su
Memoir of 1863 appeared. In them we may have
clue to Du Noyer's positiveness about the inve
of certain beds, now justified by Dr. Shackle
But there is nothing of this evidence in the me
in which references to current-bedding are cu
The cause of the suppression may with some cert

found in differences of temperament that existed en Jukes and his junior officers.

vould be satisfying to know whether any of k Ganly's drawings survive. More information that observer and about his possible contact u Noyer would be most welcome. Probably porary letters still exist which contain in- ion regarding the respective parts played by rish geologists in interpreting current-bedding applying the results to determine tectonic ons of strata. Du Noyer died young, and to as artist and as maker and interpreter of geo- l maps, it seems that justice remains to be . His field-maps, so numerous and so careful, rved in the offices of the Geological Survey of have a beauty of their own that can only be red with the subsequent achievement of rth.

ARCHIE LAMONT.

ogical Department,
The University,
Birmingham, 15.
May 7.

eton, R. M., "The Succession of Rocks in the Dingle Peninsula, Kerry", *Proc. Roy. Irish Acad.*, B, **46**, 1–12, 4 figs., pls. II (1940).

J. B., and Du Noyer, G. V., "Explanation of Sheets 160, 161, and Part of 172 . . . Illustrating Part of the County of ry", *Mem. Geol. Surv. Ireland*, p. 25 (1863).

John, "Notes upon the Errors of Geology Illustrated by rence to Facts Observed in Ireland", pp. 156–158, 161–163, . 1–2, plate 9 (1864) (London: Longmans, Green, Longmans, berts and Green).

t., pp. 6–7.

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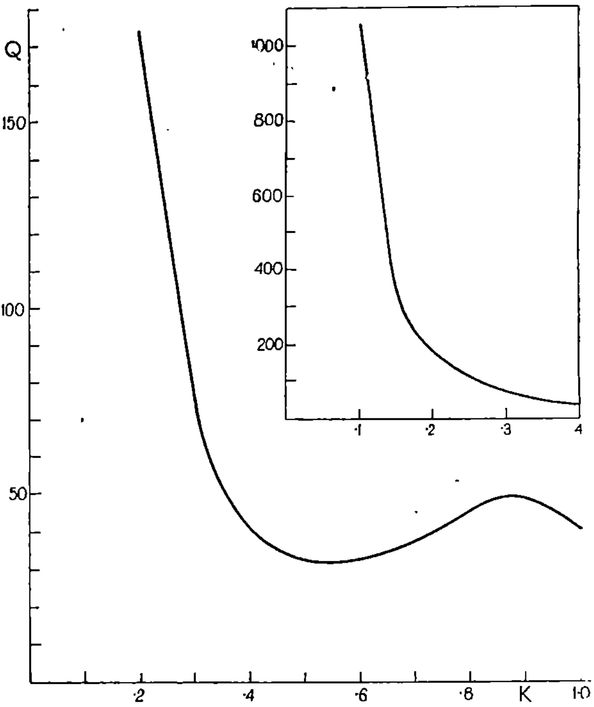
ross-section of Atomic Oxygen for lastic Collision with Electrons, and Region *F* Absorption

is now generally agreed that the higher regions he atmosphere—beyond 150 km.—consist pre- antly of atomic oxygen. The absorption of waves in Region *F* of the ionosphere which ove this level is thus caused by collision of ons with neutral oxygen atoms. If one wants timate theoretically the frequency of such on, a knowledge of the cross-section for elastic ion of atomic oxygen becomes necessary; we therefore thought it desirable to calculate it uantum mechanics methods for various electron gies up to 13 volts. The method employed for erical solution is that developed by Hartree[1] for determination of self-consistent fields. The s obtained are shown in the accompanying curves. ollisional cross-section is seen to increase rapidly anner not observed for the cases of N_2 and O_2.[2] act that atomic oxygen exhibits the Ramsauer , as seen from the figure, is of importance in nterpretation of absorption processes occurring egion *F*.

e curve may be utilized for calculating the sional frequency in Region *F*. If the temperature he region be taken as 1,000° K., after Martyn Pulley[3], and density of oxygen as 4×10^9 atoms c., after Mitra and Rakshit[4], then the collisional ency calculated by using the appropriate cross- on obtained from the curve is found to be 10^3/sec. This agrees with the value 2×10^3/ which is the mean of the values obtained by s workers from radio measurements[5]. It l be pointed out that even a large change in the ed value of temperature of the electrons does not produce any marked change in the calculated value of the collisional frequency. This is because an increase in collisional frequency due to the increased average velocity is roughly balanced (as may be seen from the curves) by the decreased cross-section. It may be noted that the collisional frequency calculated by taking the gas kinetic cross-sections yields a value of only 70 per sec., which shows that for such slow collisions as occur in the ionosphere, one must use the quantum mechanics calculated cross-section and not the gas kinetic cross-section.



Q, CROSS-SECTION OF O I FOR ELASTIC COLLISION WITH ELECTRONS.

K, $\sqrt{\frac{\text{ELECTRON VOLT}}{13\cdot53}}$

It is, however, interesting to note that for Region *E* the collisional frequency calculated by taking the gas kinetic cross-sections of N_2 and O_2 (predominant gases in Region *E*) agrees with the result obtained by radio method. This, as has been pointed out[6], is due to the fact that the values of gas kinetic cross-sections of N_2 and O_2 accidentally agree with those computed by quantum mechanics for the range of electron energy considered.

A fuller and more detailed account will shortly be published in the *Indian Journal of Physics*.

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S. P. GHOSH.

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May 2.

[1] Hartree, *Proc. Camb. Phil. Soc.*, **24**, 89 (1928).

[2] Fisk, *Phys. Rev.*, **49**, 167 (1936).

[3] Martyn and Pulley, *Proc. Roy. Soc.*, A, **154**, 455 (1936).

[4] Mitra and Rakshit, *Ind. J. Phys.*, **12**, 47 (1938).

[5] Farmer and Ratcliffe, *Proc. Roy. Soc.*, A, **151**, 370 (1935). Bailey and Martyn, *Wir. Eng. and Expt. Wir.*, **12**, 122 (1935). Eckersley, NATURE, **135**, 435 (1935).

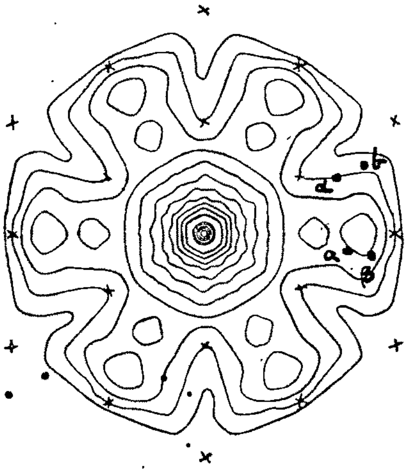
[6] Ray, *Science and Culture*, **3**, 679 (1938).

Patterson Projection of the Skeletons of the Structure proposed for the Insulin Molecule

IN a communication in NATURE[1], Riley and Fankuchen claim to have disproved the structure C_2 predicted for the insulin molecule[2] by means of a Patterson projection of the cyclol skeletons. Great weight has been given to this result[3,4]. My opinion was[5], and is, that the claim to have produced from the $(C{-}C{-}N)_{288}$ skeletons arranged at a tilt of 6°, a Patterson projection which has high intensities where they should be low (at *A*, points midway between pairs of adjacent molecules) and low intensities where they should be high (at *B*, points midway between trios of adjacent molecules) proves little in view of the fact that less than 27 per cent of the crystal has been considered[6].

Recently I have examined closely the bases of the claims advanced in this article. They rest upon (1) the basal projection of the C_2 skeleton shown in their Fig. 1; (2) the corresponding Patterson map in their Fig. 2; and (3) the Patterson map obtained by superposing the individual maps in the crystal lattice shown in their Fig. 3. I find that (1) is incorrect. It contains 850 atoms whereas it should contain 3 × 288 = 864 atoms. While the absence of two of the atoms appears to be due to misprints, the other 12 missing atoms seem to have been overlooked. Further, since it is claimed that "those parts of the cyclol molecule which have definitely and precisely been worked out by Wrinch" have been taken into account, it is necessary to point out that all the 288 C_β atoms and the skeletal oxygens have been omitted from consideration. (2) The tilt of the molecules is not defined by the crystallographical data. It is, however, obvious from Riley and Fankuchen's Fig. 2 that a small tilt (say, 0–10°) gives low *A* intensities and high *B* intensities, whereas a large tilt (say, 30–40°) gives low *B* intensities and high *A* intensities. The former is the situation found by Crowfoot[7] in her projection calculated from X-ray intensities, and a small tilt of about 6° (see NATURE, **142**, 582, Fig. 2) has been suggested by Wrinch[8] and by Wrinch and Langmuir[9] on the basis of the strong $(8, \bar{7}, \bar{1}, 0)$ reflection and for a number of other reasons.

To make the situation as precise as the rough sketch map allows, there is reproduced herewith Riley and Fankuchen's Fig. 2, to which have been added the points *a* and *b* and the points α and which represent, when the tilt is 36° and 6°, one h and one third, respectively, of the intensities at and *B*. The sketch map is unsupported by numerical values calculated, but numbering contours 0, 1, 2 . . . inwards, it appears t (roughly) $a = 2{\cdot}75$, $b = 0{\cdot}75$, $\alpha = 1$ and β giving $A = 5{\cdot}5$ and $B = 1{\cdot}5$ for a tilt of 36°, $A = 2$, $B = 9$ for a tilt of 6°. Although it is stat by Riley and Fankuchen that a tilt of 6° has b chosen, an examination of their Fig. 3 shows th tilt of 36° has been chosen, giving of course h intensities at *A* and low intensities at *B*.



On the basis of the facts here pointed out, all claims of these authors fall to the ground and th laborious calculations (assuming that the omitt atoms do not seriously affect their Patterson ma appear to show that the contrary of what they say true. With a tilt of 6°, they appear to have prov that the Patterson map of the C_2 skeletons gives l intensities at *A* and high intensities at *B*, in accordan with the findings of Crowfoot.

DOROTHY WRINCH

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[1] NATURE, **143**, 648 (1939).

[2] Wrinch, *Science*, **85**, 566 (1937); *Trans. Faraday Soc.*, **33**, 1 (1937).

[3] Bernal, meeting of the Physical Society, Dec. 20, 1939.

[4] Bernal, Fankuchen and Riley, NATURE, **143**, 897 (1939).

[5] Wrinch, NATURE, **143**, 763 (1939).

[6] Neville, NATURE, **143**, 803 (1939).

[7] Crowfoot, *Proc. Roy. Soc.*, A, **164**, 580 (1938).

[8] *J. Amer. Chem. Soc.*, **60**, 2005 (1938).

[9] *J. Amer. Chem. Soc.*, **60**, 2247 (1938); *Proc. Phys. Soc.*, **51**, (1939).

Depth of Focus of Microscope Obje

IT is usually assumed that the depth of fo of a well-corrected microscope objective is giv one or other of the following formulæ:

$$(A)\quad t = \frac{\lambda\sqrt{N^2 - (\mathrm{N.A.})^2}}{(\mathrm{N.A.})^2}$$

(Hardy and Perrin: "Princi Optics", p. 511.)

or

$$(B)\quad = \frac{\lambda}{4N\sin^2\left(\frac{1}{2}\sin^{-1}\frac{\mathrm{N.A.}}{N}\right)}$$

(Conrady: "Dictionary of A Physics", vol. 4, p. 222).

where N is the refractive index of the medium thro which the light travels, λ the wave-length of the li used, and N.A. the numerical aperture of the objecti

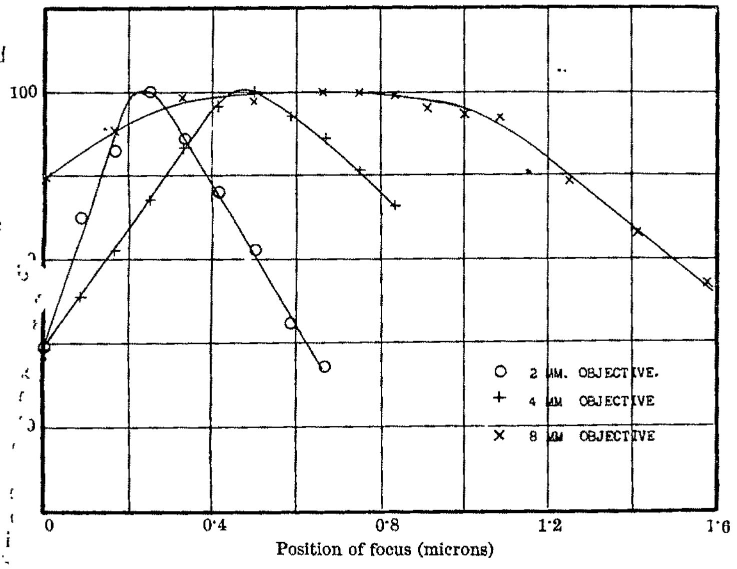
These formulæ lead to the following depths focus for the objectives given, in light of wave-len 5000A.

Objective	N.A.	Depth of focus (micro Formula *A*.	Formul
2 mm. oil immersion ..	1·30	0·22	0·3
4 mm. dry	0·95	0·18	0·3
8 mm. dry	0·65	0·90	1·0

Graton and Dane[1] have, however, pointed out t the depth of focus appears to be much less tha expected theoretically, and I have recently m some investigations on the subject.

Very fine dust particles, mounted dry and ran down to a size known to be smaller than 1/10 mic have been photographed in blue-green light methods described elsewhere[2] using Beck apoc matic objectives of the above types. By cour the numbers of particles photographed on p taken at foci varying by about 1/12 micron, estimate of the depth of focus of the objective obtained. The results, after correction for curvure of field present in the photographs, are plotted the accompanying graph. It must be noted that different objectives photograph down to different s of particles, and this factor makes it impossible compare the curves with each other.

t will be seen from the graph that with both the mm. and 4 mm. objectives, when the focus is out either side of the best focus by more than about . micron, the number of particles photographed significantly less than the maximum number otographed. The finest particles photographed the best focus have a thickness which is not known actly but which is believed to be of the order of 06 and 0·09 microns for the two objectives respect- ely; this amount must be subtracted from the parent depth of focus. It seems certain, therefore, at both these objectives have a depth of focus of ss than 0·15 micron, and the depth of focus may tually be very much less. This could be deter- ined more accurately by using a still finer adjust- nt, but, at present, time does not permit of this estigation.



With the 8-mm. objective a certain portion of the rve is flat, but the flatness does not extend over a nge of more than 0·70 microns; as the thickness of rticle photographed with this objective is prob- ly of the order of 0·14 microns, it seems that the pth of focus of this objective is certainly less than 55 microns and may be about 0·40 microns.

Naturally these depths of focus are increased by e adaptability of the eye when the objective is used sually.

It is obvious from these results that the present rmulæ for the depths of focus of microscope jectives give values which are considerably higher n those found experimentally.

This letter is published by kind permission of the d Producers Committee of the Chamber of Mines.

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pt. Soc. America, 27, No. 11 (Nov. 1937).

dle, *J. Sci. Inst.*, **16**, No. 8, 262.

Diffraction Maxima in X-Ray Photographs

IN a recent communication[1] C. V. Raman and P. Nilakantan report the presence in Laue photographs of weak intensity maxima which cannot be interpreted as Laue spots. They suggest that the new maxima are due to lattice vibrations which cause stratifications of density with the same spacing as the lattice planes, but with an orientation variable between wide limits.

The effect observed by these investigators is not new. Such weak spots are commonly found in Laue photographs taken with an X-ray beam containing characteristic as well as continuous radiation. If the incident beam does not contain appreciable amounts of characteristic X-rays, radial streaks rather than spots appear in the Laue photographs. Earlier investigators have directed attention to these streaks or spots[2], and G. D. Preston (l.c.) demonstrated that the intensity of the spots increased with the temperature. Moreover, I presented a detailed theory of the effect before the American Physical Society at its meeting on December 1, 1939. An abstract of this paper was published in November last in the *Bulletin of the American Physical Society* and afterwards in the *Physical Review*[3].

According to this theory, the lattice vibrations cause diffuse scattering of X-rays showing a rapid intensity variation with the scattering direction. The intensity maxima are to be found in the directions u_m given by the equation $(1 + \lambda\tau)u_m = u_0 + \lambda B_H$, where u_0 is the direction of incidence, λ the wave-length of the X-rays, B_H a reciprocal lattice vector and τ the wave vector associated with a mode of vibration of the lattice.

The assumption of Raman and Nilakantan that the new maxima are due to lattice vibrations is thus confirmed. It should be pointed out that the positions of the maxima are not given by the Bragg law as Raman and Nilakantan seem to suggest. In the Laue photograph of diamond reproduced in their communication, the auxiliary maxima appear at a scattering angle of 43° 0′ ± 25′, as compared to 43° 16′ deduced from the equation given above and 43° 58′ from the Bragg equation.

W. H. ZACHARIASEN.

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May 31.

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[1] NATURE, **145**, 667 (1940).

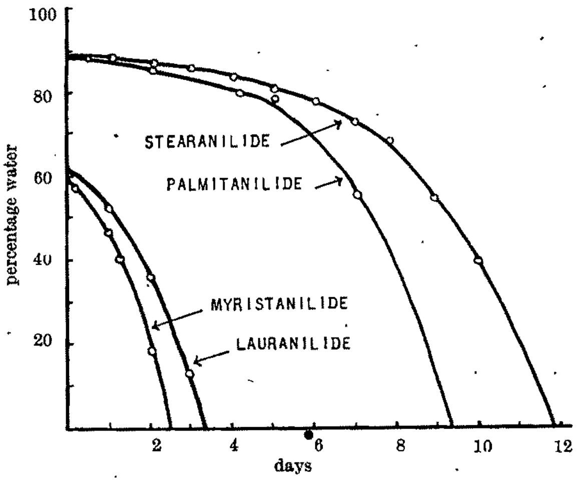
[2] See for example, Friedrich W., *Phys. Z.*, **14**, 1082 (1913). Preston G. D., *Proc. Roy. Soc.*, A, **172**, 116 (1939).

[3] For detailed accounts see Zachariasen, W. H., *Phys. Rev.*, **57** 597 (1940); Siegel, S., and Zachariasen, W. H., *Phys. Rev.*, **57** 795 (1940).

Hydration of Anilides of Normal Fatty Acids

I HAVE previously described the formation of hydrated stearanilide[1]. An investigation of some of the factors influencing the binding of water by substituted amides of the normal fatty acids is now in progress. Since experiments of an exploratory character had shown that both the amount of water taken up and the tenacity with which it is held vary with the mode of hydration, a standard procedure for the production and examination of the hydrated compounds has been adopted.

5 gm. of the pure anhydrous amide is dissolved in 50 c.c. hot absolute alcohol and the solution rapidly stirred into 1 litre of cold distilled water. The hydrated amide, precipitated as a bulky white mass, is allowed to float in the water for 20 hours. It is then filtered off at the pump, drained by suction, spread out on a porous plate and dried over fused calcium chloride for 24 hours at atmospheric pressure. Samples (5–10 gm. each) of the material are examined by heating to constant weight in an oven (the oven temperature being about 10° below the melting point of the anhydrous amide) and by drying in open Petri dishes over fused calcium chloride both at ordinary pressure and *in vacuo*. In this way the total water content of the material is determined and an assessment of the tenacity with which it is bound can be attempted.



As a start, the influence of chain-length on water-binding capacity has been studied by examining the hydrated anilides of stearic, palmitic, myristic and lauric acids. In the accompanying figure are shown the percentages of water in samples of the hydrated compounds at intervals during drying over fused calcium chloride at ordinary pressure. It would seem that the ability to 'bind' water is possessed only by stearanilide and palmitanilide, for although both myristanilide and lauranilide take up considerable amounts of water, neither is able to hold it firmly enough to resist ordinary desiccation.

At this stage it seems not unreasonable to suggest that the water of hydration is held in the interstices of a micellar structure. Points in support of this view may be summarized thus : (1) the large amount of water bound, (2) both the anhydrous and hydrated anilides are hydrophobic, (3) heating the hydrated compounds to within about 5° of the melting point of the anhydrous amide results in the setting free, in liquid form, of all the bound water[1].

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May 6.

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[1] NATURE, 145, 227 (1940).

Carrageen Mucilage

FOR some time we have been studying the mucilaginous polysaccharides of carrageen moss, and now seems desirable, in view of the recent letter b Dillon and O'Colla[1], to communicate some of o results.

Preliminary experiments on the composition of t polysaccharide (hot extract) obtained by extractio with hot water as described by Haas[2] has confirme his view that this was essentially the calcium salt a carbohydrate ethereal sulphate, analysis of t ash (19 per cent) giving Ca, 5·6 per cent, SO_4, 12·5 p cent calculated on the original hot extract, tot SO_4, 24 per cent.

Acetylation with pyridine and acetic anhydrid under various conditions and for long periods wa completely unsuccessful both on the hot extract an other carrageen extracts. It is significant that th acetolysis method of Dillon and O'Colla[1] caused extensive degradation, not only removing th ethereal sulphate residues but also the non-galactosic components.

Hydrolysis yielded a mixture of sugars containin galactose (*c.* 50 per cent) and this appears to be th main building unit of the molecule although it accompanied by other sugars. According to th results of Dillon and O'Colla[1], the galactose seems t be contained in the most resistant portions of th molecule since by their acetolysis method galactan appear to be produced. Although the rest of th hydrolysis mixture yields glucosazone, contains small amount of pentose, and gives some colou reactions for a ketose, its composition is as y undecided.

Direct methylation of the hot extract proved d cult and the methoxyl content could not be incr beyond *c.* 15 per cent, the ethereal sulphate res however, being retained. Hydrolysis followe acetylation and distillation in a high vacuum yie a dimethyl hexose triacetate (*c.* 40 per cent) an monomethyl hexose tetra-acetate (*c.* 20 per ce both of which on methylation and suitable treatm gave tetramethyl galactopyranose anilide in go yield, and deacetylation followed by osazone for tion yielded 6-methyl *d*-galactosazone and *d*-galacto zone respectively. If one assumes a pyranose ri to be present, although this is not necessarily t case, and takes into consideration that the pol saccharide is non-reducing and that therefore C_1 i involved in the linkage between adjacent units, i appears that in some units at any rate the second 'polysaccharide link' is on either C_3 or C_4 with th ethereal sulphate residue in the vacant position. I is clear, both from the methoxyl content of the methylated polysaccharide and from the isolation o 2-methyl galactose derivatives, that unless on hydroxyl group—probably on C_6—is occupied i some units by a residue resistant to methylatio there must be some shielding effect, possibly due t the sulphate residue, and this may also explain th difficulties of acetylation. The presence of tw ethereal sulphate groups on one anhydro-galacto residue must be excluded, for this would require much higher sulphate content than is observe Finally, since the hot extract is essentially a calciu salt, adjoining chains of carbohydrate residues mu be joined together by the divalent element, and t may have some bearing on the highly viscous so tions which are obtained and the difficulties acetylation and methylation.

Further work is in progress on the non-galactosic portion and also on the polysaccharides extracted by cold water.

E. G. V. Percival.
J. Buchanan.

Chemistry Department,
University of Edinburgh.

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[1] Dillon and O'Colla, Nature, **145**, 749 (1940).
[2] Haas, *Biochem. J.*, **15**, 469 (1921).

Native State of Proteins in Egg-White

There are two opposing conceptions of the native state of proteins in biological fluids. One holds that the native particle is a complex of the various species of proteins present and is altered in the process of isolation. The other supports the independent existence of these species in a state of homogeneous dispersion. Difficulties of separation and inconstancy in amino-acid analyses support the former, and these were encountered[1] in efforts to separate and characterize the proteins in hen's egg-white. Block[2] has suggested the existence of an 'orosin' in egg-white on the basis of the ratio of arginine, histidine and lysine. The evidence from physical methods with blood serum supports the second hypothesis, but these have not been applied to egg-white except for a brief note by Svedberg[3] relative to irregularities in the sedimentation constant of native and 'purified' ovalbumin.

Egg-white has been examined in the ultra-centrifuge at 60,000 (± 300) r.p.m. in a field strength of 270,000 times gravity using the 'diagonal schlieren' method of Philpot[4] in the optical system and a high-pressure mercury vapour lamp. The temperature of the rotor was 25–27° and the period of spinning up to five hours. Native egg-white and that diluted with 1 per cent sodium chloride from one to three times exhibited a single sedimenting boundary. The concentration of total protein varied from 9·8 to 2·6 per cent, measured by the Zeiss dipping refractometer and light of wave-length 546 mμ.

The differentiation of the native proteins in the white was attempted on the basis of ionic mobilities by the method of Tiselius[5]. The migration of the boundaries was followed optically by the 'schlieren' method using a sodium vapour lamp. The native or diluted egg-white was dialysed previously at 2° against a phosphate buffer mixture of pH 7·2 and 0·1 μ ionic strength until equilibrium was attained and chloride removed. Egg-white diluted three times, twice and once with buffer solution and exhibiting concentrations of total protein of 1·95, 2·75 and 4·00 per cent, separated into five and sometimes six boundaries. The electrophoresis was continued for three hours at a potential gradient of 120 v. and 10 mA. and a temperature of 1° C. In the most concentrated preparation three of the bands were heavy and three relatively light. A fresh preparation, with a protein concentration of 5·57 per cent, made with a phosphate buffer of pH 8·0 and 0·1 μ ionic strength gave a similar result in five hours of migration. The concentration of the original egg-white was 9·77 per cent. It has not been possible to study the migration of the native white without some degree of dilution by phosphate buffer. However, this is in remarkable agreement with the conclusion of five distinct protein components reached by Hektoen and Cole[6] on the basis of immunological reactions. The chemical methods of separation would, therefore, seem to have a degree of justification.

The chemical individuality of the products thus separated was tested. Using methods previously described[1], ovomucin and ovomucoid were very carefully fractionated and obtained in solution after dialysis against phosphate buffer of pH 7·2. Such solutions were never homogeneous. The best preparation of ovomucin showed a single boundary by electrophoresis but two by centrifugation in a concentration of 1·33 per cent. A specially purified preparation of ovomucoid showed three migrating boundaries in the Tiselius apparatus at 2·7 per cent concentration but only one sedimenting boundary in the centrifuge. The results thus appear to justify the further conclusion that our chemical methods are not yet adequate for the separation of the five or six species of protein in native egg-white.

The present note is published at this time because no further work appears possible in the immediate future. I wish to acknowledge the kind hospitality of Sir John Ledingham and Dr. A. S. McFarlane at the Lister Institute during the summer months of 1938, and the sympathetic assistance of Mr. R. A. Kekwick.

E. Gordon Young.

Dalhousie University,
Halifax, Canada.
April 22.

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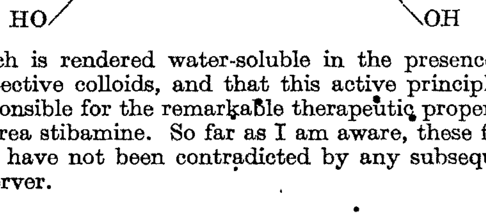
[1] Young, *J. Biol. Chem.*, **120**, 1 (1937).
[2] Block, *J. Biol. Chem.*, **105**, 455 (1934).
[3] Svedberg, Nature, **128**, 999 (1931).
[4] Philpot, Nature, **141**, 283 (1938).
[5] Tiselius, *Trans. Faraday Soc.*, **33**, 524 (1937).
[6] Hektoen and Cole, *J. Infec. Dis.*, **42**, 1 (1928).

Chemistry of Urea Stibamine

In his article on the "Antimony Treatment of Kala-azar"[1], Sir Leonard Rogers referred to the findings of an early worker on the constitution of urea stibamine; reference was not made to later work on this subject, notably that of Gray *et al.*[2].

To some extent the controversy about the constitution of urea stibamine is comparable to that about atoxyl when it was discovered by Ehrlich. Gray *et al.* have noted that the most interesting of the more important derivatives of p-amino-phenyl stibinic acid is a material prepared by Brahmachari (1922) under the name 'urea stibamine' by heating P-amino-phenyl stibinic acid with urea solution. They have shown that the 'essential active principle' in urea stibamine is S-diphenyl-carbamide-4 : 4 distibinic acid



$$O = \overset{HO}{\underset{HO}{Sb}}.C_6H_4.NH.CO.NH.C_6H_4\overset{OH}{\underset{OH}{Sb}} = O\,,$$

which is rendered water-soluble in the presence of protective colloids, and that this active principle is responsible for the remarkable therapeutic properties of urea stibamine. So far as I am aware, these findings have not been contradicted by any subsequent observer.

I would also point out that Gray *et al.* found fairly constant results from analysis of urea stibamine (Brahmachari), as shown in the accompanying table (the discrepancy in the antimony content of samples examined by them being due to varying amounts of the protective colloids present):

Carbon	Hydrogen	Nitrogen	Antimony
—	—	6·75	44·19
—	—	6·77	44·49
20·2	3·0	—	—
20·9	2·9	—	—
20·5	2·8	—	—
20·9	3·0	—	46·4
21·53	2·67	—	—
21·16	2·8	—	46·8
20·17	2·91	6·47	48·6

As already noted in NATURE[3], the divergent results obtained by different investigators were due to the fact that various manufacturers put on the market so-called urea stibamine which did not conform to my specification. This no doubt led to the conclusion of early workers that the so-called urea stibamine varied widely in its antimony content and was uncertain in its composition.

UPENDRANATH BRAHMACHARI.

19 Loudon Street,
Calcutta.

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[1] NATURE, 144, 1103 (1939).

[2] *Proc. Roy. Soc.*, B, 108, 54 (1931).

[3] NATURE, 145, 546 (1940).

Cultivation of Bluetongue Virus in Fertile Eggs produced on a Vitamin-deficient Diet

Two of us (R.A.A. and J.H.M.) have made many unsuccessful attempts to infect mice, guinea pigs, rabbits, hamsters, hedgehogs, and chicks with bluetongue virus. Mice and guinea pigs were not rendered susceptible by blockading the reticulo-endothelial system with India ink, by deep X-ray therapy, or by maintenance on a vitamin-deficient diet of autoclaved oats. Finally no multiplication occurred in normal developing chick embryos when virus was seeded on the chorio-allantoic membrane, or in the yolk-sac (method of Cox, 1938).

Various workers, particularly in the United States, have shown that deficiencies and intoxications can be produced in eggs, if the hens are put on appropriate rations. Thus, eggs may be obtained that are low in vitamins A, D, and E, pantothenic acid, riboflavin and manganese: if the diet contains much selenium, for example, the embryo is poisoned. It occurred to one of us (J.D.W.A.C.) that although bluetongue virus did not multiply in a so-called normal egg, yet it might grow in some of these 'pathological' eggs. We decided to infect eggs produced on a diet known to be deficient in the curled-toe-paralysis preventive factor, which is possibly riboflavin. Eggs laid by hens on a supposedly normal ration were also used, as a control.

In both groups, each hen had free access to water and oyster-shell grit and got about 1·5 oz. crushed yellow maize each evening, and a little more than 0·5 oz. chopped, fresh lucerne each morning. Dry mash was left before the birds all day. The two mashes were made up as follows:

	Deficient Mash lb.	Normal Mash lb.
Yellow maize meal	30	30
Pollard	30	30
Wheaten bran	20	20
Meat and bone meal (55% protein)	7·5	15
White fish meal (68% protein) ..	7·5	0
Lucerne meal (average quality) ..	0	5
Dried brewer's yeast	0	3
Common salt	0·5	0·5

Basing our calculations on American figures, we may assume that a hen given the deficient mash ate about 180 micrograms riboflavin per day. As a hen needs at least 230 micrograms daily for her eggs to develop properly, it is obvious that the deficient ration is low in riboflavin. Hens on the normal mash took in the adequate amount of approximately 270 micrograms riboflavin each day.

We used the above deficient diet because our colleague, J. J. Bronkhorst, had proved in chick experiments that the fish meal and the ration as a whole was very low in the curled-toe-paralysis preventive factor. It was he, too, who kindly supplied all the eggs for these experiments.

The virus for the 'pathological' eggs was a 10 per cent saline emulsion of infected sheep spleen, filtered through an 860 mμ gradocol membrane; 0·2 c.c. was inoculated into the yolk-sac of each egg containing a six-day-old embryo and the eggs incubated at 36° C. Serial passage was carried out every 4 or 5 days by subinoculating yolk-sac emulsion into the yolk-sacs of 'pathological' eggs.

With this technique the virus has been carried through 21 egg-to-egg passages with irrefutable evidence of multiplication. The yolk-sac, the embryo, and the chorio-allantoic membrane contain virus; in one experiment each was shown to hold between 100,000 and 1,000,000 infective doses for sheep.

After 4 passages in 'pathological' eggs, the virus was able to grow in normal eggs and could be maintained in them easily. At the present moment, the adapted virus is in its 37th normal egg passage. One experiment has shown that the virus content of normal eggs may be much lower than that of 'pathological' eggs.

As a rule, infected embryos die in 4 or 5 days, and are cherry-red when dead or dying.

Whether it really is the deficiency of riboflavin in the diet that has enabled us to propagate bluetongue virus in 'pathological' eggs remains to be seen, and experiments will soon be conducted to settle the question. At least twenty deficiencies and intoxications and combinations of these can probably be produced in eggs, and it would seem as if 'pathological' eggs might support the growth of other viruses that have not been cultivated in normal eggs. However, we may mention that neurotropic and viscerotropic strains of horse-sickness virus and the rickettsias of rat typhus and tick-bite fever multiply no better in 'pathological' than in normal eggs.

J. H. MASON.
J. D. W. A. COLES.
R. A. ALEXANDER.

Department of Agriculture and Forestry,
Division of Veterinary Services,
Onderstepoort,
South Africa.
April 24.

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[1] Cox, H. R., *Pub. Hl. Rept.*, 53, 2241–47 (1938).

Pining in Sheep not Curable by Cobalt Administration

Work in Australia has shown that deficiency of alt in the diet is responsible for characteristic orders of sheep and cattle. The view that a sheep ease known as 'pining' results from cobalt de- ncy was advanced by Corner and Smith[1], who med that cobalt administration prevented and d this disease north of the Scottish border. In opinion these experiments were inadequately trolled. During a large-scale investigation of ing' in the Cheviot area south of the border, ertaken in collaboration with Dr. Taylor and . Green of the Veterinary Laboratory of the nistry of Agriculture at Weybridge, a well-con- rolled experiment was carried out to test the curative effect of cobalt on sheep suffering in varying egree from this disease. Cobalt solution was ad- inistered for five months to one half of the sheep, e other half being left as untreated controls. The ath-rate from 'pining' was as high in the treated as untreated group, and at the end of the experiment treated sheep were no better than the controls udged by body-weight records and hæmatocrite mations. The details of this experiment have n described in a recent number of the *Veterinary ord.*

n a preliminary report[2] the view was expressed us that 'pining' in the area concerned was caused interaction between malnutrition and parasitic festation, the worm species *O. circumcincta* being pecially incriminated. Field investigation over the t three years has shown that 'pining' may be evented either: (1) by feeding a special mineralized ke containing considerable quantities of calcium l phosphorus as well as small amounts of iron, balt, copper and other trace elements; or (2) by stematic anthelmintic treatment to remove worms. e mineralized cake may have prevented 'pining' y removing specific mineral deficiencies or by obviating undernutrition in the more general sense y supplying additional protein and calories. Al- ough administration of cobalt has failed to cure ning, the possibility is not ruled out that specific ficiency of this element may play an initial part in me areas in the cause of pining by lowering re- tance to parasitic disease. There is, however, no dence for this view apart from the fact that sitic infestation has been controlled and 'pining' vented by feeding a mineralized cake containing alt as well as other trace elements. Our investi- ions are being extended with the object of eliminat- the non-essential constituents from the pining- venting cake and continuing observations upon thelmintic treatment.

The claims of Corner and Smith for the specific nificance of cobalt have been recorded in bio- emical and medical as well as in agricultural erature, and it is therefore thought of general terest to direct attention to the article entitled Pining not Curable by Cobalt Administration" ing published in the *Veterinary Record*.

W. Lyle Stewart.
A. Phyllis Ponsford.

Veterinary Branch,
gricultural Department,
King's College,
Newcastle-upon-Tyne.
May 6.

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[1] rner and Smith, *Biochem. J.*, 32, 1800 (1938).

[2] ewart and Ponsford, *J. Comp. Path. and Ther.*, 49, 49 (1936).

Practical Science in Schools

A communication from my former biology master, Mr. A. G. Lowndes, in Nature of June 1, p. 863, cannot, I feel, be allowed to pass without an answer. Since the time when I was very ably taught by Mr. Lowndes with plenty of laboratory work, I have become a biology examiner both in scholarships and School Certificate. I have, therefore, experienced the results of laboratory work in biology at school from two aspects in quite a short space of time, and my conclusions are the very opposite to those expressed by Mr. Lowndes.

Candidates for scholarships come up knowing advanced genetics, but when presented with a twig of larch they do not recognize it nor can they make a constructive effort to understand it. Similarly, they know all the details of stomatal mechanism, but the stoma that they draw would be quite incapable of opening and closing as described, and in one case a candidate admitted that he had never really properly examined one. I can, therefore, only believe that this result is achieved by too much book and lecture work and too little laboratory work. On Mr. Lowndes' scheme there will be a tendency for children to acquire knowledge which they do not properly understand because they have not handled the material for themselves.

Furthermore, I sincerely believe that a plant or animal which has been handled and cut up can be remembered very much more readily than the same plant or animal described and demonstrated. I remember that I learnt very much more of plant systematics at school when I collected and identified two hundred flowers than at the University when I saw many of them as demonstrations.

In this letter I only feel qualified to refer to biology, and so I may perhaps add that I believe one great asset of laboratory work is that one learns to draw accurately what is observed, and there cannot be too much of this, especially as many who come up to the university are very poor in this respect.

As I understand the problem, the solution would be for the universities to demand a smaller syllabus so that adequate time is allowed for laboratory work and the student becomes really grounded in the fundamental facts. I also find it difficult to subscribe to a statement quoted in an article on the same subject in the same number, namely, that the function of the teacher is "to stimulate wonder and imagination". I should have thought that a better function would be to stimulate understanding and appreciation.

I realize that *elementary general biology* is perhaps in a different category but I would still maintain my thesis, namely, that, so far as possible, actual examination of specimens helps one to remember better than any amount of talking.

V. J. Chapman.

Botany School,
Cambridge.
June 2.

We are glad to publish the above views of a member of a university staff who has also examined school students of biology. It should be borne in mind, however, that the majority of secondary school students do not proceed to a university, and furthermore only a minority of those who do so continue their studies in the science faculties. Science in schools, therefore, is only one of several disciplines and should be treated as such. Over and over again the criticism that the school curriculum caters too much for the university candidate and too little for that majority, who complete their 'formal' education at the School Certificate stage, has been made in NATURE and elsewhere. This criticism is now meeting with a certain amount of response. Science teaching is still too much concerned with the presentation of factual information, by experiment or otherwise, and too little with its social and humanistic contacts. It is not the business of the schools to train academic, professional and industrial experts, but rather to produce intelligent and knowledgeable citizens. Dr. Chapman's views are justified from the point of view of a biologist looking for good, sound biological material to train as specialists. That scholarship candidates "come up knowing advanced genetics, but when presented with a twig of larch they do not recognize it" betrays an unbalanced syllabus. School science should "reveal the influence of scientific thought and achievement in the evolution of our present-day civilization—an appeal to social interest and utility". It has been shown that "factual knowledge and knowledge of scientific method can be imparted as successfully by demonstration as by practical work". While not advocating the complete abolition of practical work, we consider that *in schools* there is too much of it; it is too elaborate and demands more time than can be justified. (Editors of NATURE.)

Relation of Working Period to Output

THE production drive in Great Britain which started a month ago has led to a very great extension of working hours throughout industry. We would urge that this matter should receive the att
scientists for the following reasons. It is
that a scientific attitude should be mainta
wards the relation between hours of work
ductivity of factory labour ; it was establ
experience during the War of 1914–18 that i
hours of work did not in all circumstances
greater production. Scientific workers as
factory hands in industry and in Governmen
are also being asked to work longer hours,
uncertain what holidays will be granted.

During the "emergency fortnight" which
the middle of May, several large firms requi
staff to work a seven-day week of total hours
from 50 to 70. We understand that in some
firms the emergency arrangements have now
an end : but even in these cases the 'pe
arrangements provide for a six-day week
hours, and the question of holidays has
fixed.

While it is difficult to assess the producti
scientific laboratory, it is evident that excessi
and reduced holidays and rest periods are
reduce the rate at which scientific and
workers conduct their theoretical, experim
supervisory work, and will also affect the q
the work. It is also important to remem
mistakes made in scientific work may ha
serious consequences, not only in increasing
of injury to the workers but also in turning o
products.

W. A. Wo

Association of Scientific Workers,
30 Bedford Row,
London, W.C.1.
June 17.

Points from Foregoing Letters

In a note on the early use of current-bedding to determine orientation of strata in the Dingle Peninsula, Eire, A. Lamont raises the question of the parts played by Patrick Ganly, John Kelly, and possibly G. V. Du Noyer in the application of this technique.

The cross-section of atomic oxygen for elastic collision with electrons has been computed using quantum mechanics by S. K. Mitra, B. B. Ray and S. P. Ghosh. Atomic oxygen is found to exhibit the Ramsauer effect, and the value of the collisional frequency in Region *F* (where atomic oxygen is predominant) computed by taking the appropriate cross-section, agrees with that obtained from radio measurements. Calculation by taking the gas-kinetic cross-section yields too low a value for the collisional frequency.

On examination of the diagrams that have been said by Messrs. Riley and Fankuchen to show the Patterson projection to be expected from an insulin crystal on the cyclol hypothesis, D. M. Wrinch finds that the angle of tilt used in their construction was not 6°, as stated by them, but 36°, and that the evidence of the diagrams is in favour of the cyclol hypothesis.

Investigating the hydration of anilides of higher normal fatty acids, B. A. Toms reports that ability to 'bind' water is shown only by those in which the fatty chain contains more than 14 carbon a
is suggested that the bound water is he
micellar structure.

By the hydrolysis of the methylated 'hot
of carrageen moss, E. G. V. Percival and J. E
have isolated derivatives of 2-methyl a
dimethyl galactose ; they discuss the bearin
result on the structure of the polysacchari

E. G. Young finds that native and dil
white in the ultracentrifuge shows only
component, but diluted egg-white in the
electrophoresis apparatus shows five and s
six migrating boundaries. The behaviour of
tions of ovomucin and ovomucoid is also d

J. H. Mason, J. D. W. A. Coles and R. A. A
find that bluetongue virus may be culti
fertile eggs laid by hens living on a vitamin
diet. The possibility is that the vitamin c
is riboflavin. After a few passages in such
virus grows easily in eggs laid by hens on
diet.

W. Lyle Stewart and A. Phyllis Pons
that 'pining' in sheep is not cured by cobal
istration. Deficiency of cobalt may be the
factor, lowering the resistance of sheep
infestation, death ultimately occurring from
disease.

RESEARCH ITEMS

-Groups and Castes

E distribution of blood-groups in certain castes e United Provinces of India has been studied N. Majundar of the University of Lucknow *ce and Culture*, 5; 1940). Recently tests were d out in connexion with an anthropometric y. Tests on 175 subjects belonging to three gave results as follows: Kayasthas (47) ·4, A 19·7, B 30·6, AB 8·3; Khatris (36) 6·5, A 21·8, B 35·0, AB 6·7; Chamars (92), 38·3, A 13·3, B 38·3, AB 10·0. Bengal data MacFarlane) show that percentages of A and B rease from the higher to the lower castes, and that highest percentage of O is among the caste dus. The increase of B among the Khatris of the ted Provinces is perhaps due to a greater ad- ure with inferior races. The Chamars possess a percentage of B and O—38·3 O as against O among non-caste Hindus of Bengal; while Kayasthas have 41·4 O. On these results it is ature to form any hypotheses; more data are ired. The castes have been endogamous groups ges. If O underrates the degree of isolation, the large percentage of O in India (43·0) among hmins and Kayasthas of Bengal and (41·4) ng Kayasthas of the United Provinces, compared 5·0 among Americans, 46·4 among English, 37·3 Germany, indicate a racial affiliation with the ious branches of the white race. On the other d, if there may be genes for O in the low-caste e with a high mutation rate for B, the decrease ng the higher castes of A, which is higher among white races, and a high value of B suggest a ial admixture, and the more we know of blood- oups the greater the possibility of determining the xtent of this admixture. The popular belief that he Kayasthas of Bengal differ ethnically from those the United Provinces is not supported.

of a Blind Cave Fish

HE blind cave characin, *Anoptichthys jordani*, ribed in 1936 is the first fish of the order Hetero- ni to show loss of ocular structure. A histological tigation of the eye by E. B. Gresser and C. M. ler, jun., shows that while the eye has definite rs, they are of poor development, so that while primitive optic vesicle has undergone its first agination, it appears at this stage to have ceased differentiate beyond a pigment layer and a retinal er (*Zoologica*, 25, 113; March 1940). The external sculature is present and an optic nerve has an line. Whether the eye stops in development ause no lens develops and produces in turn the on of the poorly developed primary vesicle into yst, or vice versa, the eye has not advanced to a ge when vision is possible. The authors consider t the histology indicates that in this case blind- s is due to a stoppage in development of the eye ctures at an early stage, rather than to de- erative changes at a more advanced stage; and y consider that the origin of such a defect as is recorded is more likely to be due to a chance ant form accidentally associated with cave life, to the gradual adaptation of a seeing fish to conditions of cave darkness.

A New Method of Rendering a Poisonous Snake Harmless

Recently, Duval B. Jaros has perfected an electro-coagulating device, with high-frequency current at about one million cycles a second, whereby the escape of venom from the poison gland of a snake and its passage to the fang is prevented by the destruction of a portion of the duct (*Zoologica*, 25, 49; March 1940). The operator can manage the entire procedure without assistance and in safety; the snake is not disfigured and its habits seem in no wise affected by the operation. Thirty-six crotalid snakes, ranging in size from eight inches to four feet, were treated and were thriving normally after forty-five weeks, the result of the occlusion of the duct apparently being permanent. In the performance of the operation the author introduced three novelties, a practical device for holding the snake, a cheap and efficient operating knife, and the use of Michel surgical clips to eliminate all danger of the operator being bitten.

Mycology in China

Several papers which show increasing study of mycology in China were contributed to the journal *Sinensia* in 1937 and 1938. S. C. Teng and S. H. Ou published part 7 (9, Nos. 5–6; September 1937) and S. C. Teng part 8 (9, Nos. 3–4; May 1938) of "Additional Fungi from China". S. C. Teng and K. L. Teng have also made a preliminary study of the Myxomycetes of China (8, Nos. 5–6; Sept. 1937). These are all detailed descriptions of species, most of which are familiar to the British mycologist, but a few new taxonomic designations have been found necessary. These include *Quaternaria microspora*, *Rosellinia culmicola*, *Clypeosphœria radicicola*, *Endoxylina citricola*, *Chrysomyxa Bambusae* and *Periconia bambusina*. The two last-mentioned occur on bamboo; the others upon deciduous twigs. Some of the work of description was performed in Nanking in October and November 1937, during the disastrous air-raids upon that city.

Life-cycle of Allomyces

Ralph Emerson has described a genetical means of discovering the life-cycle of Allomyces (*Mycol. Soc. Amer.*, Dec. 30, 1939). Species of the sub-genus Euallomyces have an asexual generation alternating with a sexual one. Zygospores give rise to secondary sporophytes, while spores from resistant sporangia give rise to sexual plants which are monœcious. The sexual plants bear male and female gametangia of different colour, and their position differs in different species. Crosses were made between species differing in these and other characters. Segregation occurs after the formation of resistant sporangia, but before the development of the mature gametophyte. The sex-determining mechanism is, therefore, phenotypic in the gametophyte.

Linkage Group in the Sweet Pea

The fourth linkage group of the sweet pea now consists of five pairs of genes (R. C. Punnett, *J. Genetics*, 39, 301–308; 1940). The characters acacia, dull flower, absence of flake-modifier, glabrous, picotee, together form a linkage group of at least 119 cross-over units. C. D. Darlington in an appendix to this paper shows that the largest two chromosomes are about 148 crossing-over units long; therefore this linkage group covers almost the whole of one of these long chromosomes. A further allelomorph G'' has been added to the flake multiple allelomorph series G, G'. G'' causes less pigment production than G'.

Genetics of Wood-Lice

THE woodlouse, *Armadillium vulgare*, is a fairly easy animal to rear in culture (H. W. Howard, *J. Genetics*, **40**, 83–107; 1940). Two varieties, red and yellow, respectively, are dominant to the commoner black and grey varieties, while two rare varieties *C* and *D* are dominant and sex-linked. The sex ratios of a progeny is rarely 1 : 1; some broods consist only of males or only of females, while others are weakly arrhenogenic or weakly thelygenic. This is determined by the female parent. The author follows Vandel's hypothesis that the female is the heterozygous sex, and that the segregation of the sex chromosomes into eggs and polar bodies is controlled by the cytoplasm. Several wild populations of *A. vulgare* were found to have an excess of females.

Applications of Statistics to Palæontology

As a result of a statistical investigation of some freshwater lamellibranchs (Anthracomya) from the Coal Measures of Scotland (*Quart. J. Geol. Soc.*, **96**, 13–37; 1940), D. Leitch has developed a method which may prove of wide application in the study of fossil groups where abundant specimens are available showing wide ranges of variation in which they appear to overlap with comparable groups at other stratigraphical horizons. He finds that regression equations calculated on various dimensions of these shells are applicable to practically all the members of the group investigated, but that a large proportion of the forms from other horizons do not satisfy the equations.

Mechanical Integrity in a Circuit-Breaker

A PAPER on the "Mechanical Integrity in the Design of Electrical Circuit-Breakers" was read before the Institution of Electrical Engineers on May 8 by M. C. Hunter, of the British Thomson-Houston Co., Ltd. Electrical investigation has been carried out since the inception of the electrical circuit-breaker to produce infallibility of operation, and more particularly to ensure that the breaker will open when required to do so, regardless of the time it may have remained in a state of rest, under load conditions, without attention. There are many other mechanical requirements to be met such as speed of making, speed of breaking, contact pressure and correct buffering for absorption of energy at each end of the stroke, but the quality of 'opening whenever called upon' is the most fundamental of all. No accelerated proving method is available which will fully replace the natural sequence of closing the breaker, leaving it on load for, say, six months and observing the result after tripping. The arrangement of parts, accelerating springs, etc., therefore demands that there shall exist an expelling force which will at all times guarantee the opening of the contacts. The determination of the required magnitude of this expelling force is not easy, and ultimately depends on the required degree of certainty with which the breaker must open under the most onerous conditions, such as inattention, rust, 'glueing in' with heat, slight freezing of the contacts, misalignment, contact roughness due to wear, contact erosion, etc. T required value may be considered to be in the natu of a 'factor of safety', or better a 'factor of assuran This term is used in connexion with both the brea mechanism and the operating mechanism. author, by means of curves and calculations, sh how approximate values of this assurance factor be obtained which would be of value in practice.

Precision Measurements in the Hydrogen Spectrum

AMONG the fundamental applications of quan theory to atomic spectra are the quantitative calc tion of the Rydberg constant in terms of *e*, *h*, *c*, and the prediction of the fine structure of the Ba lines. The latter, as calculated from the relativ wave-mechanics of Dirac, is the same in separa and intensity distribution as that given by the theory of Sommerfeld. J. W. Drinkwater, Sir O Richardson and W. E. Williams (*Proc. Roy. S* A, **174**, 164) have investigated the wave-lengths structures of the α-lines of hydrogen and deuter using the reflecting echelon of Williams, which this purpose a new and advantageous spectros technique. The source of light was a discharge cooled in liquid air. The value of *e/m* for the el calculated from the wave-lengths is in good a ment with recent measurements on free elect This removes a suspicion that there was a systen difference between 'spectroscopic' and 'free elec values of this ratio. The separation and inten of the fine structure components were in satisfa agreement with the theory. The limit to the acc of this test was apparently set by a backgroun the hydrogen molecular spectrum.

Energy in the Solar Ultra-Violet

A REPORT of five years work at the Mount Wil Observatory on the energy distribution in the ul violet solar spectrum has recently been published E. Pettit (*Astrophys. J.*, **91**, 159; 1940). Th observations differ from the author's previous wor at Tucson, Arizona, in being on the radiation from the centre of the disk, rather than on integrated sunlight. The light was fed from an aluminized sidereosta mirror through a double quartz monochromato o to a vacuum thermopile, the second slit of the monochromator being made adjustable so as to pass 100 A. of the spectrum at all wave-lengths. The results, reduced to no atmosphere by transmission coefficients which agree well with those of the Smithsonian observers, yield spectral energy curves similar to those obtained at Tucson: the intensity drops by 50 per cent between 4000 A. and 3800 A., remains nearly constant to 3250 A., and then falls at a linear rate with wave-length to a very low value at 2920 A. To eliminate so far as possible the effect of Fraunhofer line absorption, auxiliary energy-curves were ob tained with a 21-ft. concave grating monochromat used in conjunction with a photocell. By sketchin in the continuum between the lines on such trac coefficients were derived by which the thermoelect curve could be reduced to one referring to the c tinuum. Even so, however, this curve shows most the previously noted depressions in the ultra-viol and is still far removed from that of a black bod The absorption spectrum of O_3, which has form the subject of a special laboratory investigation, shown to be insufficient to account entirely for form of the curve, and its departures from the bla body type are to be regarded as real.

RECENT ADVANCES IN MARINE BIOLOGY

BY DR. N. B. EALES

HE recently published Journal of the Marine Biological Association contains nineteen papers biological subjects, and the report of the Council the year 1938.* The report records the bequest the Association of £6,500, instruments, books and paratus under the will of the late E. T. Browne. research room has been named the Browne morial Room, and will contain furniture from . Browne's laboratory and his valuable reference rary on Cœlenterata. The new constant tempera- e rooms are in use and other improvements have en made in the buildings, especially in accommoda- n for research workers.

Six papers record ecological investigations. P. rtley gives an account of the tuck-net fishery on fine mud of the Tamar and Lynher estuaries. net was used at monthly intervals for two years e Saltash area, and the estuarine fishes, their , migration and frequency distribution are ribed. Most of the fish go to the sea to spawn. iteral invasions of cormorants, jellyfish and nalopods seriously impair the value of the ng.

. Milne, in the fourth of his studies on the ecology ie Tamar estuary, deals with the fauna and flora oating buoys. Weeds attach themselves in con- rable numbers and compete with mussels for a Sessile animals are to be expected, but isopods, hipods, crabs, worms and echinoderms live in the ices. As the result of permanent submergence, wever, some littoral species cannot survive, for ample, *Littorina littorea*. The extent of estuarine netration was studied.

J. Colman surveyed the well-known collecting area nown as Church Reef, Wembury Bay, and examined he invertebrate fauna in relation to eight species of seaweed. He records 35 animal species new to the Plymouth Fauna List, out of a total of 177. There re surprising omissions, for example, *Obelia geniculata*, Tectibranchs and Nudibranchs, and the compound Tunicates *Didemnum asperum* and *D. maculosum* on the Laminaria holdfasts. A large number of Polychætes was found. A comparison of terrestrial and marine faunas elicits the fact that the marine fauna is the denser of the two. *Ascophyllum nodosum*, with its epiphyte *Polysiphonia lanosa*, houses the greatest number of individuals.

C. Rees studied the ecology of a mud flat in the Cardiff area, by means of horizontal and vertical samples. The microfauna and the chemical and physical factors of the water were investigated and quantitative survey of the macro- and micro-fauna ere attempted. The interactions of the observed henomena are discussed.

H. B. Moore, in his second paper on the biology *Littorina littorea*, made a survey of the zonation this species in five localities in the Plymouth area d one on the island of Skye. Unable to endure nstant immersion, this species has a definite lower it; it does not extend below low-water springs l is most abundant at mean low water of the neap es. The upper limit varies with the locality and algal growth, but the molluscs require wetting by the sea every tide, and do not reach above high water neaps. Young individuals occur near the upper limit, the largest near the lowest levels. G. Spooner and H. B. Moore, in their sixth paper on the intertidal muds of the Tamar estuary, record the macrofauna. Quantitative samples were taken and provided data regarding population density, up-river penetration and vertical distribution. The effects of water currents at low tide levels on population and the zonation of certain species were also studied. This fauna supplies food for fishes brought in by the flood tide and for wading and shore birds during the ebb tide period. The paper is profusely illustrated with graphs and distribution charts.

There are three papers dealing with life-histories. E. H. Myers worked on the life-cycle of four species of the foraminiferan Discorbis. Since the flagellate stage occurs within the test, it is possible to demonstrate the production of 'zoospores' by crushing. In *D. patelliformis* 250–300 triflagellate zoospores—more correctly gametes—are formed within one shell. At this period, however, two or more individuals unite to form multiple tests, each participant being a mononucleate megalosphere. After fertilization of the gametes multinucleate microspheric individuals with two or three chambers are formed within the megalospheric test, and each undergoes asexual reproduction to form mononucleate megalospheric individuals again. The complete life-cycle can be completed in just over 64 days.

Marie Lebour adds to her valuable researches on the larval stages of Crustacea an account of the larvæ of the Pandalidæ. F. Gross has two papers dealing with the life-history and osmotic relations of the diatom *Ditylum brightwelli*.

Contributions of a biochemical and physiological nature include a study of the nitrogenous and phosphorus requirements of phytoplankton, and the intensification of their growth rate by chemical means by H. Harvey, of the phosphorus and iron requirements of two species of Sagitta by R. J. Harrison, and on the average obliquity of illumination under water by W. Atkins and H. Poole. They describe a cubical photometer for obtaining their results.

The variation in the type of inheritance shown by echinoid hybrids in different years led S. Hörstadius to study crosses between *Psammechinus miliaris* ♀ (*Z* type from the shore and *S* type from the Eddystone) and *Echinus esculentus* ♂. It is remarkable that during 1909–11 the inheritance was maternal, in 1912 it was paternal, while in 1932 it was mixed. The effects of temperature, *p*H and salinity are discussed, but no definite cause for the difference was established.

There are three investigations on subjects of economic importance. F. S. Russell continues his records of the seasonal abundance of young fish, although unfortunately, owing to the War, the record for 1939 stops at the end of August. Previous records show that the last four months of the year are negligible, since the earlier months cover fully the period of production. The 1939 results are the worst

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Journal of the Marine Biological Association of the United Kingdom, 24, No. 1. (Cambridge: At the University Press, 1940.)

since the slump year of 1924, despite the fact that no change in the plankton was noted. J. H. Orton reports on the oyster beds of the Fal Estuary. On the banks the beds are in poor condition, largely owing to dirty culch. Overgrowth of sponges and Lithothamnion is a troublesome factor. In the river, conditions are better and it is suggested that clean culch from this region should be spread over the banks every June to assist in recovery. *Crepidula fornicata* has not appeared in the area. The experimental rearing of oyster larvæ over five seasons at Port Erin Biological Station provides the material for a lengthy report by J. M. Bruce, Margery Knight and Mary Parke. This important piece of work deals chiefly with the food supply of the larvæ, an cultivation of algal zooids acceptable to them. in some respects supplementary to H. A. work on the biological and physical condi affecting oyster culture at Conway. Six flag organisms were eventually chosen and cultivate were fed to the veliger larvæ under stabilized physical conditions, either separately or mixed. most successful were those labelled H and I, gre yellow or golden brown flagellates 3–6 μ in diam Using them as food, more than 90 per cent o larvæ settled as spat. The adaptation of the ex mental results to commercial practice is the problem to be solved.

LARGE-SCREEN TELEVISION PROJECTION

THE application of television has so far been restricted by the difficulty of obtaining received pictures comparable in size and brightness with those produced by the cinematograph, whether used in the home or in places of public entertainment. Consideration of the matter leads to the conclusion that this objective is unlikely to be achieved until it is practicable to apply the principles of optical projection of the pictures, using a standard form of light source of a magnitude suitable for the size of picture required.

In an article published in the February–March issue of *Electronics and Television and Short-Wave World*, Dr. A. H. Rosenthal describes a new electronic device by means of which such projection may be realized, without the disadvantages accompanying the use of an intermediate film on which the picture is first recorded photographically and then projected in the usual manner. The principle of the device is based upon the discovery by E. Goldstein in 1894, that certain materials, normally transparent to visible light, become coloured, that is, more or less opaque, when they are subjected to bombardment by cathode rays. Examples of such materials are the halides of the alkaline earth group, and potassium chloride has been used in the application of this discovery to television reception.

In the instrument developed by Dr. Rosenthal, which he terms a 'Skiatron', the screen of the cathode-ray receiving tube is replaced by a plate of potassium chloride crystals, mounted between two light-transparent electrodes. As the plate is scanned in the normal manner by the beam of electrons, opaque deposit is produced, the density of whic everywhere proportional to the instantaneous tensity of the beam. The screen thus carries du each frame period a complete quasi-statio picture, which may be projected optically in a ma similar to that employed with a cinematograph The opaque deposit is removed by the applicatio a steady electric field between the electrodes pl on either side of the crystal, the speed of oblitera increasing with the field strength and also increase of temperature of the crystal.

In the instrument under development, the nitudes of these quantities are chosen so that 'picture' deposits are removed in the interval betw successive scannings. Owing to the fact that picture being projected is quasi-stationary, as c pared with the continuously varying one produ on the fluorescent screen of the usual cathode- tube, the picture repetition frequency used in 'Skiatron' can be reduced to a value just sufficient avoid flicker. If this advantage is substantiated practice, the effective band of radio frequencies quired by the television transmitter will be reduc

In the article referred to, Dr. Rosenthal illustra an arrangement of using three of these special tu for reproduction of coloured pictures. Each catho ray tube with its special crystal screen and a suita light filter operates at one of each of the th primary colours used, and the illumination is p jected directly through the three screens in successi to obtain the coloured resultant picture.

PROBLEMS OF EVACUATION

THE report of an inquiry, which has been pursued by the Department of Social Science of the University of Liverpool, financed by a grant from the Charities Fund of the Liverpool Council of Social Service, into problems of evacuation has now been published under the title "Our Wartime Guests—Opportunity or Menace" (Liverpool: University of Liverpool Press. London: Hodder and Stoughton, Ltd., 6*d*. net). It emphasizes the importance of a determined effort to profit as much as possible from the mistakes of what may prove to be only the first of a series of evacuation schemes. Like the interim report, which dealt with the evacuated areas, the present report is based on house-to-house visiting, this time in the recepti areas. The results of these 412 interviews lead to reassuring conclusion that the evacuation schem despite its voluntary basis, has not entirely brok down. The majority of the hosts behaved splendi and succeeded in making the children entrusted them happy. Many of the parents co-operated to best of their abilities.

That the scheme was not a complete success w due to faulty organization in the billeting of dirt verminous and enuretic children; the removal children from their billets by parents on the impul of the moment; the unwillingness of some hosts